

# Aviation Week & Space Technology

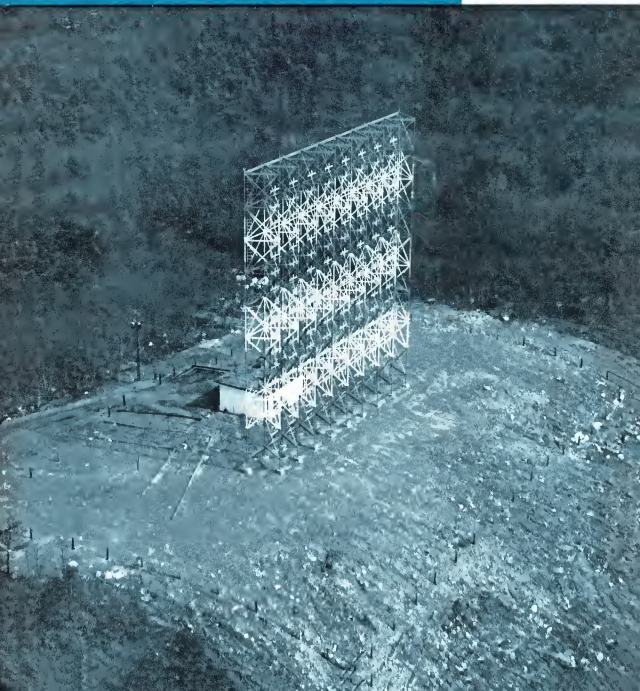
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A McGraw-Hill Publication

June 24, 1963

**X-21 Testing  
Laminar Flow  
Control Theory**

**FAA Tropo-Scatter  
Antenna on Cape Cod**



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For complete information about the Honeywell 6140, the Vaneorder Oscillograph, and other recording equipment, contact your nearest Honeywell office, or write: Honeywell, Denver Division, Denver 16, Colo. Or call us direct at 303-750-4501. Be Controls, contact Honeywell Controls, Ltd., Toronto 17, Ontario.

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## AEROSPACE CALENDAR

July 1-3—Composites and Supersonics for Space Engineering Society, Shantou Jiafeng Hotel, St. Louis, Mo.

July 7-11—Research National Conference on Aerospace Education, National Aerospace Education Council, Hotel Drexville, Miami Beach, Fla.

July 9-11—International Symposium on Space Telecommunications, Institute of Electrical and Electronic Engineers, Boulder Laboratories, Boulder, Colo.

July 10-12—Microelectronic Symposium for Aerospace Testing and Operation, American Institute of Aeronautics and Astronautics and American Meteorological Society, Ft. Collins, Colo.

July 13-17—17th Annual Florida Fall Derby, Balmorhea, Gulf to Atlantic City, N.J.

July 14-20—19th Annual International Convention, The Sheraton Hotel, Sheraton Hotel, California City, Calif.

July 15-16—Space Propulsion Conference (Confidential), American Institute of Aeronautics and Astronautics, U.S. Naval Undersea Warfare Laboratory, Newport, R.I.

July 20-21—Symposium Society for the Control Engineering Systems, Lockheed Research Laboratories, Palo Alto, Calif. Sponsors: U.S. Navy's Special Research Office, Lockheed Martin & Space Co. July 20-Aug. 4—11th Annual Fly-In Convention, Experimental Aircraft Assn., Redford, Ill.

(Continued on page 7)

## AVIATION WEEK & SPACE TECHNOLOGY

June 24, 1963  
Vol. 76, No. 25

Continued from page 6  
The first of the new series of aircraft is the Lockheed L-1011-1 TriStar, which is scheduled for delivery in 1968. It is a three-engine, wide-body jet aircraft, with a capacity for 300 passengers. The second aircraft in the series is the Boeing 747-200, which is scheduled for delivery in 1969. It is a four-engine, wide-body jet aircraft, with a capacity for 400 passengers. The third aircraft in the series is the McDonnell Douglas DC-10-30, which is scheduled for delivery in 1969. It is a three-engine, wide-body jet aircraft, with a capacity for 300 passengers. The fourth aircraft in the series is the Airbus A300-600, which is scheduled for delivery in 1970. It is a two-engine, wide-body jet aircraft, with a capacity for 200 passengers. The fifth aircraft in the series is the Boeing 777-300ER, which is scheduled for delivery in 2005. It is a three-engine, wide-body jet aircraft, with a capacity for 300 passengers.

Aviation Week and Space Technology is a leading authority on the latest developments in the aerospace industry. It covers a wide range of topics, including aircraft design, manufacturing, testing, and operation. It also covers space exploration, satellite technology, and the development of new propulsion systems. The magazine is published weekly, and is available to subscribers for a nominal fee.

Subscription: Please send \$5.00 per year to Aviation Week and Space Technology, P.O. Box 1000, Detroit, Michigan 48201.

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The costly, complex weapons systems of today make such a decision far more difficult than in the past. World wars have ended and are frequently avoided. The time for decisions has been compressed; the information available must be based has been multiplied as politics, variables, uncertainties, and so forth.

This new era of decision-making has led commanders and governmental leaders to make use of man-machine systems which provide information processing assistance. SOCA staff of scientists, engineers and computer programmers have been developing these large systems for more than eight years.

They help develop the system itself, not the hardware within the system specifically. They analyze system requirements to evaluate the system, estimate components which are the core of the system, how the system, evaluate the system, adapt it to the changing needs of the users. And in so doing, they consider the interaction and effect of men, computers, machines, human-organism, them-as command and control-succesful, of communication, stable control, command post, computer and display. Human factors concerns operations research however systems-oriented engineers and computer scientists.

graduates interested in joining the rapidly expanding field and working in a close interdisciplinary effort are invited to write Dr. W. E. Bass, SOC, MIT, Cambridge Ave., Santa Monica, California. Positions are open at SOC facilities in Santa Monica, Washington, D. C., Deshler, Massachusetts, Paramus, New Jersey, and Dayton, Ohio. "An equal opportunity employer."



Systems that help men make decisions and

Aug. 48—International Conference and Exhibit on Aerospace Support, Institute of Electrical and Electronics Engineers, American Society of Mechanical Engineers, Park Sheraton Hotel, Washington

Aug. 43-46—South African Institute on Metals and Space Technology, University of Cape Town, South Africa

Aug. 17-18—Eighteenth Annual Technical Symposium, Society of Photographic Instrumentation Engineers, Ambassador Hotel, London

Arg. 1836—Fifth Annual Gas Dynamics Symposium, Northwestern University, Aerospace Institute of Aeronautics and Astronautics, Evanston, IL

■ **ABOUT THIS SERIES** Things are happening with CD fuel cells. Each month brings new advances in the technology—and occasionally we have really significant developments to announce. Hence these reports. They're our efforts to help those interested in possible uses of our fuel cells bring those and plans interested. Keep informed of what's happening behind the scenes of our fuel cell business.

How long can a cell self-renewal to prove that a wild daughter property does not exist? The answer, says Michael Casper's group at MIT, lies in the number of times a cell divides. In a 1990 paper, Casper's group reported that the number of divisions a cell can undergo is limited by the number of times it can divide. This is the first time that a cell's self-renewal has been shown to be limited by the number of times it can divide.

In March, we wrote in this column about a fuel cell that uses hydrogen—oxygen to produce electricity. Now, we have a second fuel cell. This one uses hydrogen and carbon monoxide. Electricity produced from work in another corner of our Research Laboratory.

In May and April, General Electric unveiled a fuel cell that converts hydro-

gen to work, and the hydrogen can come from the liquid element in the column. It's the so-called direct fuel cell. It's a fuel cell that can be operated with no preheating of the hydrogen gas to form more than enough water to balance this loss in the treatment of the metal. The element was 11,000 cc.

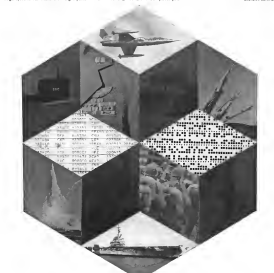
hydrocarbon—nickel complex at moderate temperatures (250–300°F.), and was obtained directly from carbonaceous feedstocks that are not gasolines. The catalysts became more effective as the carbonaceous feedstocks contained more hydrogen. The hydrocarbon—nickel complex was reduced to metallic nickel and completely lost its activity. The catalyst was not deactivated by sulfur compounds in the feedstocks. The catalyst was stable in the presence of water and oxygen, and was not deactivated by these compounds.

[illegible]

Another way to build interest in the atmosphere is to form carbon dipeptide, hydrogen ions and disulfide ions to the following reaction:  

$$\text{Acidic } \text{C}_2\text{H}_4 + 2\text{H}_2\text{O} \rightarrow \text{CO}_2 + 2\text{H}^+ + 2\text{e}^-$$
  
 Carboxy dipeptide is regarded from the cell. Electrons are considered and all the cell.

**GENERAL  ELECTRIC**



ANALOGUE WEEK 8. SPACE TECHNOLOGY, June 24, 1967



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## AEROSPACE CALENDAR

(Continued from page 7)

Inst. Space Institution of Electrical Engineers (London), American Institute of Aeronautics and Astronautics Institute of Electrical and Electronic Engineers, Instrument Society of America

Sept. 21-26—Second Annual Symposium on the Physics of Failure in Electronics, Claremont 18, sponsored by the Development Center, American Research Foundation

Sept. 25-Oct. 1—19th. Congress, Internat. Union Astronautical Federation, Paris

Sept. 18-Oct. 1—Manual Interpreting Exposition Meeting, American Institute of Aeronautics and Astronautics, Canada Motor Hotel, Palo Alto, Calif.

Sept. 30-Oct. 2—Canadian Electronics Conference, Institute of Electrical and Electronic Engineers, Electronics Inst., Toronto, Canada

Oct. 1-3—Eightieth National Symposium on Space Electronics, Institute of Electrical and Electronic Engineers, Fairbanks Hotel, Miami Beach, Fla.

Oct. 6-8—National Aerospace Nuclear Safety Topical Meeting, Aerospace Nuclear Society, Albuquerque, N. M. Co-sponsored by Atomic Scientific Laboratory, AEC, Aerospace Operations Office, AF Special Weapons Center, AF Directorate of Nuclear Safety, Sandia Corp., University of New Mexico

Oct. 2-8—National Assn. of Air Traffic Specialists, Sheraton-Oldline Hotel, Dallas, Texas, Calif.

Oct. 7-9—North Atlantic Communications Symposium, Institute of Electrical and Electronic Engineers, Hotel Ohio, Ohio

Oct. 9-11—21st Annual Aerospace Electronics/Electronics Conference, Aerospace Electrical Society, Pan Pacific Auditorium, Los Angeles, Calif.

Oct. 13-17—4th Annual Meeting and Conference, Airport Operations Council, Research Hotel, New Orleans, La.

Oct. 14-18—Eightieth Annual Exposition and Symposium, Air Traffic Control Assn., Sheraton Hotel, Dallas, Tex.

Oct. 18-19—Eightieth Symposium on Satellite Models and Space Technology, Naval Training Center, San Diego, Calif. Sponsored by AF Space Systems Div., AF Ballistic Systems Div., Aerospace Corp.

Oct. 18-19—Fourth National Vietnam Symposium, American Vietnam Society, Sheraton Hotel, Boston, Mass.

Oct. 27-30, Oct. 31-22—North Atlantic Aerospace Conference, American Institute of Aeronautics and Astronautics-Canadian Astronautics and Space Institute-Royal Astronautical Society, Massachusetts Institute of Technology, Cambridge, Mass.

Oct. 31—17th. Queen Elizabeth II, Victoria Canada (Oct. 21-31)

Oct. 23-25—Twentieth Annual East Coast Conference on Aerospace and Navigational Electronics, Institute of Electrical and Electronic Engineers, Emerson Hotel, Baltimore, Md.

Oct. 23-24—Conference on Spaceflight Systems, National Aeronautics and Space Agency, Dayton, Ohio. Sponsored by Aerospace Research Division's Propulsion and Flight Dynamics Laboratory

Oct. 24-26—National Electronics Conference, McCormack Place, Chicago, Ill.

## Remember the Navy "Blimps"?

ING UMBRELLA OVER THE OCEANS...



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"Look ahead over Nature's range, Nature's mystery lies in change!"

—ROBERT BURNS

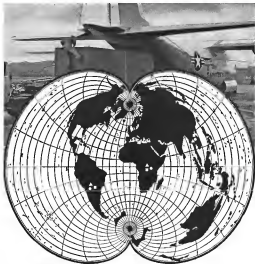
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Volume 75  
Number 28

**FEATURES**  
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**COVER STORY**  
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# Aviation Week & Space Technology

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#### EDITORIAL

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**COVER:** New investigation-aircraft communication facility in Barnstable, Mass., one of two under test by Federal Aviation Agency, is expected to show three double the weight of VHF ground communications. The 100-ft high antenna shares and a similar one near San Juan, Puerto Rico, were built by Pape Communications Engineers, a subsidiary of Northrup Corp. For more details, see p. 103.

#### ADVERTISING

Direct-Mail Campaigns for the month: 24, 25, 26, 27, 28, 29, 30, 31, 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th, 10th, 11th, 12th, 13th, 14th, 15th, 16th, 17th, 18th, 19th, 20th, 21st, 22nd, 23rd, 24th, 25th, 26th, 27th, 28th, 29th, 30th, 31st.



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## EDITORIAL

### Perspective on Paris

The 25th Paris Air Show dissolved in a red, green and white mist left drifting in the late twilight sky at Le Bourget after the superb double beach head battle of the east-glass Indian airborne team. The Indians' most recent performance in their F-86 Sabers, included to always several new additions to the world's aerodynamic repertoire. It was a fitting closure not only to the best day of international formation aerobics in a long, long time but also to the 10-day-long show that once again amazed previous years in technical interest.

The final day at Le Bourget left seven aerobically team members in various depths of sleep with an occasional moment of wakefulness arising from the credible Sabers to the Mach 2 Swedish double-edged Drakens and the British P-1 Lightning.

The two new additions to the Le Bourget aerobically stable—the Czech air force team flying Sabers and the Swedish air force flying the delta-winged Drakens—added distinctive flavor to the already familiar ingredients offered by the USAF, French, British and Italian teams.

The Greeks added grace and elegance to the program with which they won their space plane initiative. The Sabers entered the sky. They surprised many observers who had never seen them before with the obvious degree of proficiency that five smaller air force has achieved in modern tropical. The Swedes were somewhat handicapped by one of the unfortunate intervals of deteriorating weather that are so common in Europe but they managed to impart some of the potential of their amazingly maneuverable Mach 2 fighters.

No matter how interesting as possible the technical discussion in the exhibits or clinics may be, it is the thing that really makes an air show, and this final weekend at Le Bourget offered more such fine things than has been seen anywhere in many a year. Among the individual virtuosi who were outstanding, special honors should go to:

- Bernard Neefs, a Belgian flying a European-built P-104.
- Ralph Drenth in the German Mikulok.
- Rene Bagnard impossibly flying the VTOL Babcock.
- Filiz Le G. G. Lora of RAF "S" Squadron piloting the Avon Vulcan through its various low-level evolutions.

Technical needs evident in the show indicated the French are still moving strong and becoming an increasingly tough competitor in international aviation. The Mustang 20 is certainly a strong entry in the still wide open market for the jet executive transport and will give the British and American competitors a stiff fight. The development of the full potentialities of the unique STOL design of the Breguet 940 exposed many obvious areas with its future held in a military aircraft and a truly rugged commercial freighter for underdeveloped areas of Africa, Asia and South America. Export sales of the Mirage 3 Mach 2 delta-wing fighter already have been good with prospects bright that it eventually will be flying under additional flags. It seems likely that the Mirage 4 nuclear bomber also will enter the export market and fly with impact other than the Trident.

Still a shadow on the competitive horizon, but one of increasing substance, is the West German aircraft industry. It is evident from the wide variety of modern conceptual studies and early development projects on display by German firms that they are close to entering

the competitive military and commercial markets with their own designs. The French team and most of "the VTOL battle of Le Bourget" between two opposing technical approaches to the VTOL problem—the vertical-lift-thrust Hawker P-1127 and the MiG-25/26 through Babcock. Both are really experimental flying vehicles for later operational versions. The British sponsored P-1154 and the French Mirage IV, which will compete heavily in the NATO markets.

The matchup to the P-1127 hardly had the technical significance attributed to it by the French. It flew precisely as the Babcock required the exact flight through they engaged. In fact, the technology of both machines is dependent on the technical bases of both countries. The British selected the usual course of vectored thrust from the Frenchman Michel Wibault, on whose patents the British Siddeley developments are based. In fact, the Babcock is powered by a battery of Rolls-Royce lift engines expressing this British firm's approach in solving the high thrust/weight ratio problems that this approach demands. The advantage is obvious: thrust competition for the next generation NATO fighter is far from over and certainly was not decided by a Sunday afternoon exhibition at Le Bourget.

The Paris Air Show has grown substantially in stature during its last three outings as a meeting place for the top technical management people of the international aerospace business. This year saw a noticeable growth in this regard, with more solid business talks than ever before and more business and offers among the Le Bourget exhibitors and shippers in place to see most of the people in a few days who normally would require months of time to contact.

As this aspect of the show grows more important, we suggest that its directors give serious thought to establishing this activity by designating several special days when the general public is barred and the show is open only to the true professionals in the field. The British Aircraft Show at Farnborough has followed this practice for years with highly beneficial results and we predict that its adoption at Le Bourget would be highly useful for the people who seek the largest portion of its bids.

No American observer at Le Bourget could have been completely happy with what transpired in these 10 days for, with some notable exceptions, the U.S. image at the show was weak. These exceptions included the USAF Thunderbolt aerobically team, the NASA space exhibit and some between flying displays. But the lack of any really new or technically exciting U.S. aircraft, and the rather lackluster flying by most of the individual military planes displayed certainly caused an impression of diminishing American strength in the international aviation market—an impression that it would be wise to correct not only by better representation at Le Bourget, but also in some less government and industry policy implementation at home.

U.S. participation in the 25th Paris Air Show certainly have many strong impressions of what can and should be done to improve the American position in the international aerospace market. We suggest that those who stayed at home listen carefully to what they have to say and give it full consideration in shaping future courses.

—Robert Harte

## A black and white photograph showing a large, circular industrial metal flange with a complex internal structure, including a central opening and several concentric rings. To the right of the flange is a smaller, cylindrical metal component with a flange at one end. The background is dark. The word "EXPENSIVE" is printed in large, bold, white capital letters at the bottom left of the image.

**SPS**

33



## What metal will work here!

**His problems:** Seeking read, sand, contaminants from rotating parts! Keeping lubricants in! And specifying the right metal assembly!

Up-to-the-minute information would tell him to select a Haynes alloy. One that provides high hardness, low friction against itself, as well as other materials... and long wear in gritty abrasive. Haynes alloys are available for virtually any corrosive, oxidative, high temperature, and other tough wear conditions.

They come as finished parts, ready to use... or as rough castings, forgings, bar stock, sheet, plate, or wire. Our 32-page properties booklet tells the facts about 15 Haynes alloys. Write Union Carbide Synthetic Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, New York.



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## Washington Roundup

### USAF Gemini Ambitions

Air Force space leaders are so pessimistic about how much they will be able to do under the National Aeronautics and Space Administration's Gemini program that they are pressing for one of their own, using the more powerful Titan 3 rather than Titan 2 for the booster after NASA has proved the spacecraft.

NASA Administrator James E. Webb and Defense Secretary Robert S. McNamara are conducting a proposal to let the Air Force perform some orbital experiments during the first 11 Gemini flights conducted by the space agency.

But even if these second experiments are approved, Air Force officials fear Titan 2 will not have the thrust needed to lift all the equipment they eventually want to add to Gemini. How Webb and McNamara react to the pending proposals will be the first real indication of how early Air Force will obtain a sizable role in the Gemini program.

Space agency's proposal to build an Electronics Research Center in the Boston area is causing a lot of state concern. Already the House space committee has decided to cut the Fiscal 1964 budget request for the center from \$17 million to \$19 million, directing NASA to submit some justification. Chairman Charles P. Anderson of the Senate space committee is equally unsentimental about the center, fearing NASA will build a badly located white elephant similar to the Atomic Energy Commission headquarters in Germantown, Md., 23 mi. outside Washington, D. C.—a location he opposed from the start.

### Webb Explains Webb

Administrator Webb turned the House Manual Space Flight Subcommittee last week first on questions of H. D. Barnard Hahn (AW June 17, p. 17) as director of manned space. Right would cause no program changes in Gemini and Apollo. Subcommittee members were prompted by the news release which Webb himself wrote about Hahn's resignation. The release said the phrase "as the resignation of the NASA named flight program." Webb has asked Dr. Robert F. Mettler, executive vice president of Spac Technology Laboratories, to replace Hahn. Dr. Mettler has indicated that he does not want the NASA job, although he is planning to come to Washington to discuss it with Webb.

### Rubel Memo Devolved

Key recommendations of a Defense Institute Advisory Committee passed to build military space selection board to evaluate proposals rather than recommending was seen (AW June 17, p. 129) in receiving a cool reception from Department of Defense leaders.

Despite Defense Secretary Russell E. Colglater last week a letter to the secretary of the Air Force, Army and Navy declaring "no new policy" has been adopted for some selection and that the services will be given "simple opportunities" to comment before any changes are made. He emphasized that the recommendation drafted by a DIAC subcommittee under John H. Rubel, former deputy director of defense research and engineering is purely a staff document "and a staff duty that the continuing studies of this subject will be completed in the near future."

Colglater told the Senate subcommittee investigating the X-22A contract award (see p. 16) that a military space selection board "should be permitted to make any recommendations it pleases," adding that he himself would want such a recommendation before making a decision on a contract award.

### Manpower Drain Probe

Drains of military and space programs on the nation's skilled manpower pool will be assessed by the Senate Subcommittee and Management Subcommittee in hearings during September and October. Chairman Joseph S. Clark also wants to question NASA and Defense Dept. officials on whether their contracting policies are adequate with regard to helping depleted areas.

Several sources are so concerned about the large amount of engineering of funds NASA does without congressional approval that they are pressing for a limit on the engineering authority as well as constant surveillance of the space agency's operations by the General Accounting Office.

Another NASA policy being challenged in Congress is the practice of giving away results of its contract research to the Communications Satellite Corp. Sen. Charles Anderson suggested that since the corporation would benefit so directly, it should pay part of the research costs. Robert C. Sweeney, Jr., NASA assistant administrator, said that "in a way that we should not be bothered for the technology that comes out of the space program as to who who uses it."

—Washington Staff



**HAWKER P.1127** is shown to dust (top) and smokes into the grass at Le Bourget. Note portion of landing gear at left. Airplane dropped at suddenly less than 20 ft. lower. As dust clears (center), crumpled nose yoke and pieces of the landing gear are visible. Extent of damage to nose landing gear and nose section is seen (bottom). In addition, right wingtip and wingtip landing gear were extensively damaged, and main landing gear have been damaged by the impact. Aviation Chief Test Pilot A. W. (Bill) Bedford has left the cockpit, shaken but unhurt. The VTOL fighter was returned to England last week for intensive workover at the Hawking factory at Bovingdon. Bristol Siddeley's Pegasus contained thrust engine also will be checked, but superficial examination has shown no indication of failure.



**ITALIAN AIR FORCE** sends a team of North American F-4E fighters to escort down the Le Bourget access runway, trailing several parallel streams of smoke. The Italians also showed a new maneuver—a nine-plane V formation at low altitude.

## Flying Demonstrations Cap Paris Air Show

By Herbert J. Coleman

**Paris—**World aviation, with the 140 aircraft exception of the Soviet Union, staged 16 brilliant hours of flight demonstrations in the closing weekend of the Paris Air Show, with technical interest centered on vertical and short takeoff and landing research.

But for another glimpse, south of the air west to the USAF Thunderbolt, which yesterday was for power, high-speed excitement and to the Greek and Italian air force jet teams, for their elegance of maneuvers.

Dismissing the presence of a large number of Soviet engine-based technicians, armed with cameras and tape recorders, the Russians declined to take up their reservation for show space with, at most, no explanation. Iron Curtain displays were left to the Yugoslavs, Czechs and Poles.

The last public flight demonstration of the Danish Blaise VTOL, prototype, watched it with the technical flight British Hawker P.1127. The latter was dropped in, but took, capped with a crash from a 20-ft. lower before 2:00 o'clock on the first day of the show (see photos at left).

The last test, started when Aviation Chief Test Pilot A. W. (Bill) Bedford arrived from Great Britain (see L4) and staged an aerobically demonstration, for which he was cheered by Le Bourget control authorities.

Suddenly, when Bedford was asked to follow the Blaise, the P.1127 seemed to start and the flight was con-



**PROTOTYPE MYSTERE 20**, shown in right turn at the Paris Air Show (above) and entering the takeoff (below), exceeded Mach 0.51 at 30,000 ft. in its previous test program. Its most direct competitor, the de Havilland DH.125, also flew on the show.





**DASSAULT MIRAGE 3** fighters make high-speed pass with auxiliary boost SEPR 344 rocket engines ignited. Over 500 of the aircraft are in

order, more than 150 delivered.



**PROTOTYPE OF THE HARRIER 1136** shows tailwing long wings, canards, jointed air-coast intake. Para Air Show flyby with boost bay doors open.

order. The trouble was traced to a blockage of one of the two streamer pump which open fuel into the Bristol Siddeley Pegasus ducted-thrust engine.

Sooner, the final show day, a second P.1127 flown by Hugh McDermott, came to look up Bedford. Minutes of American approval was finally obtained to fly both in the show. After a short takeoff from the grass, Bedford made a series of high-speed passes, followed by McDermott, and then returned to start his hovering demonstration which included about 180 deg. turns around the aircraft's vertical axis.

While hovering, the nose suddenly dipped and the engine cracked into the ground, sending out the landing gear and damaging the nose section and a wingtip. Bedford was shaken but unhurt. Among the first on the crash scene were the designer, Sir Sidney Camm, and K. L. Lockie, managing director of Hawker Aircraft. Meanwhile, heavy weather continued its downpours. Before returning to the camp to make an extremely light vertical touchdown.

**DASSAULT MIRAGE 4** has jet Mach 2 strike-bomber built. (7) Le Bourget during flight demonstrations using drop parachutes for deceleration. All three prototypes of the aircraft appeared at the show, in a flyby with Mirage 3 fighters. Note weapon bay fully

Bedford's plane was returned by surface transport to England last week where technicians will attempt to find the trouble. Speculation was that the nose control jet may have malfunctioned. The engine hot section appeared to be normal after the initial inspection. The P.1127 has made about 500 transitions without accident.

From an airborne standpoint, the P.1127 troubles allowed the French a clear day when the Bolue performed perfectly in runs before President Charles De Gaulle and the public. The airplane, flown by Dassault Chief Pilot René Sigard, took off vertically from a special ramp. The Bolue was secured to a grid by a chain damaged on its touchdown which was released when the Rafal-Bolue RD 325 pure lift engines reached full-thrust power.

From aloft the Bolue flew to the operational runway, lowered its main gear and then transformed to forward flight by tilting the Bristol Siddeley Olympus main propulsion engine and settling down the bank of AP 10's. Accelerating rapidly, the Bolue flew

**NAVY VERSION** of the Sud Super Frelon helicopter has similar configuration to first prototype designed to Army specifications. Principal external change is the position of the rotor system added to the two main landing gear units.



**MIRAGE 4 PROTOTYPE** makes inverted low altitude pass over show area.











# Gilpatrick Cites Knowledge of X-22A Firms

By George C. Weiss

Washington — Personal knowledge about the management of Ball Aerospace Co. and Douglas Aircraft Co. strengthened industrial considerations in deciding which firm should get the X-22A, V/STOL dual-role research vehicle contract, according to Deputy Defense Director Kenneth L. Gilpatrick.

"I made the best judgment I could in the light of the long experience and knowledge with the aerospace industries," Gilpatrick said, in explaining to the Senate Preparedness Investigating Subcommittee why he awarded the X-22A design "I got adequate cost information in all the letters," he said, before deciding the contract should go to Ball because of its "experience and past performance." The contract, valued at \$15.5 million, is for two full-scale research vehicles.

## Somebody's Concern

The explanation, pronounced Sen. Robert Goldwater (R-Ariz.) to stress that the X-22A and F-117 (TFX) programs indicate that reversing military technology evaluation "is becoming the accepted way of doing business" under current Defense Dept. leaders. "It fits this debate the pattern," he said. "Congress has to speak out against it." Sen. Stuart Symington (D-Mo.), however, and Gilpatrick "did exactly the right thing." Both senators are members of the subcommittee.

Gilpatrick said he agreed with the principles Allen, George W. Anderson, outgoing chief of staff of aerospace, expressed in his affidavit filed with the subcommittee, but did not believe those principles were violated in the

X-22A award. Allen, Anderson said that receiving military recommendations "without adequate and thorough consultation is dangerous" and "can only be detrimental to the competitive spirit of American industry." He said technical evaluation "should not be overruled except for the most compelling and persuasive reasons" (AW June 17, p. 31).

Gilpatrick said there was "adequate consultation," noting that he had talked with Dr. James H. Whitlow, Jr., assistant secretary of the Navy for research and development, and Dr. Harold Brown, director of defense research and engineering, before making his decision.

"Secondly," Gilpatrick said, "I did not disregard the technical evaluations of the experts. I did not override the source recommendations because none was better or not. I did not try to take into account the factors of experience and of performance as being anything new being brought into the general rules of source selection. I think industry generally knows that these factors are to be taken into account. I think they are applied on in all of our detailed regulations and in situations. While I agree with the point that Allen, Anderson makes, I do not think that these points are applicable, in contrast, of the decision making process in this matter."

Gilpatrick said he knew the House of Naval Weapons preferred the Douglas design, but that Whitlow did not rule any recommendation to him any value that the X-22A contract. Gilpatrick said that he was not aware after his decision that it was the House of Naval Weapons evaluation report that recommended the contract go to Douglas. Allen, Anderson concurred with the

recommendation. Whitlow himself concurred with the House's technical evaluation, but he thought Gilpatrick's decision was the right one "because I think there is more involved than just the technical proposal. I think the past experience and performance of the contractor has to be considered."

A major consideration, Gilpatrick said, was Ball's better emphasis in records, as contrasted to Douglas' concentration on production. "I know what the Douglas Co. had done, I know what the Ball Co. had done," he said. "I know that the Ball organization was very extensively research oriented, they had gone in more for experimental methods, just steadily in the V/STOL field. Now the Douglas Co., if you look out at its roster of live aircraft, you will see they [Douglas] are more oriented towards transport and defense products. In the [V/STOL] field, except for the reaction they brought when they entered Doolittle, after the completion of a similar development, they had no experience. It is not a reflection on a company that has been established in the field. But that was the distinction I drew in making the decision that I did."

## Kearley's Opinion

Although other witnesses testified that Navy Secretary Paul Kirk seemed neutral in the X-22A competition, because he formerly served as a director of Ball, Gilpatrick and he called Kirk "as far as that assignment of the Ball Co. to me in that position had indicated."

"I did not ask him for a vote as between the two which should be chosen. I did ask him to give me his judgment based on his close association with the Ball Co., as to the ability and quality of its management. That was the only check I made, outside of my own knowledge and the discussions of course I had had with Dr. Brown. But I was well familiar with the records of both companies and with their reputations in the business."

Sen. Henry M. Jackson (D-Wash.) said that before deciding the Navy's technical evaluation presents that involved 75 people and took 4,800 man-hours and making the decision on management grounds, there should be a detailed examination of the management capabilities of the competing firms.

"We need to have the documents, the findings and the information that caused the decision to be made on our behalf," he said.

Although the X-22A hearings are in indefinite cases, Sen. Goldwater and Jackson, for the rest of the competi-



## Lead Jet to Have T-Tail; First Flight Delayed

Adoption of a T-tail configuration for the Lead Jet, which the company says was done to take advantage of expected growth in engine performance, will delay the first flight of the bomber from budget aircraft from the original June target date until late summer. Stabilizer overhaul, but has increased June 5 day, to 25 day, which Lead Jet will increase maximum cruising speed from Mach 5 to Mach 7.5. Mock-up shown, is shown at the White, Memphis Airport. Configuration target date is the first quarter of 1984.

several series, will be among those in Congress challenging the type of "rough paragraph" used by Gilpatrick on the X-22A case, and by Defense Secretary Robert S. McNamara in endorsing the author's F-117 recommendations (AW May 6 p. 26). Other testimony, during the X-22A hearings June 12, 13 and 14 showed these conflicting comments.

Shelby substance Dr. Harold Brown, director of defense research and engineering, said in his June 15, 1982, recommendations to Gilpatrick on the X-22A competition that Ball "has considerably more experience" in V/STOL aircraft and performance, Douglas' current performance as a variety of jobs, notable, St. Louis, has been very questionable. Gilpatrick said "When I came to make my decision in the X-22 matter, I was not influenced by the Shelby statement."

Woodward's substance George Yeager, Jr., chairman director of the House of Naval Weapons, said "the technical competence of a producer is measured by the design that he submits in a competition." Brown said "If you compare the quality of the design of the pieces of paper that are turned in is response to a request for proposal, then you clearly cannot take into account who it is that made the proposal, in terms of how much he knows and what past personal experience with him has been."

Chief someone develops a successful criteria for past performance, you are going to be left with impression is a source of people's judgment on this is the

## Telstar 2 Radiation Damage Slight

Telstar 2 is reported to be in excellent operating condition after more than a month in orbit and indications are that the communication satellite is being exposed to considerable less damaging space radiation than its predecessor.

Early data from two lightly shielded sensor sensors, consisting of magnetometers designed to be especially susceptible to cosmic damage, indicates that Telstar 2 experienced no such damage in one week as Telstar 1 has experienced during its first month. This was expected because of Telstar 2's higher apogee, which results in spending less time in the heart of the intense Van Allen radiation belts and because of the design of radiation produced by the high-energy Telstar 2's nuclear reactor test of July 8, considerably prior to launch of Telstar 2.

During Telstar 2's first month in orbit, a total of 273 technical tests and 45 public demonstrations have been completed.

Because the Telstar 2 satellite has a higher apogee than Telstar 1—6,711 vs. 5,770 mi.—the level of both belts and passes through has been somewhat lower, averaging about -70 % dose compared with -82.6% dose for Telstar 1.

Telstar 2 was used to relay television pictures of Soviet retirement Col. Viktor Pavlov in his Vostok 3 to American space.

Features of the mission was transmitted by Soviet Interscope TV system, received in Helsinki and put into European television network, which reaches West Europe.

The Soviet program was typed in London and communicated to the U.S. through the British Consulate, Moscow communication satellite ground terminal.

Telstar 2 is spinning at a rate of 179 rpm, compared with an initial spin rate of 177 rpm for Telstar 1. Spin rate is 93.9 day, relative to a line connecting the satellite and the sun, covered with range of 80-100 day for Telstar 1.

Telemetered data indicates that this temperature at the satellite's upper pole ranges between 157° and 161°, with temperature range of 8°/F at the lower pole, which occurs in mid-light. Temperature of the communication container is running 73-75°F, the same as for Telstar 1.

Precursor answer to microwave pressure of the payload network shows it has been rising gradually due to diffusion of trapped gases in the polysulfone foam used for encapsulation. The rising process, which shows there is no hole in the container, is expected to stabilize in the communication satellite soon.

The power output of Telstar 2 is decreasing 125 milliwatts, slightly higher than Telstar 1.

## NASA Uses Rubel Procurement System

Washington—National Aeronautics and Space Administration's source selection policy for major systems essentially identical with the environmental policy recommended by Defense Dept. by John H. Rubel, former deputy director of the office of defense matters and engineering (AW June 15, p. 121), according to testimony last week by John D. Young, NASA's director of administration.

Young told the House subcommittee system selection policy, headed by Rep. Carl Albert (D-Col.), that the "selection" of the contractor by NASA awards of over \$15 million is made by NASA's three top administrators: those are James Webb, administrator, Hugh Dryden, deputy administrator, and Robert Seamans, associate administrator. Source selection boards of technical and business managers select specific evaluation contracts proposed by the system by the top three. He said he is applying to question the system of NASA procurement.

NASA will utilize the contractor taking system being developed by Defense Dept. (AW Apr. 18 p. 3). The system will evaluate the past record of contractors on cost, schedule, and technical performance.

Non-profit organizations will have no significant role in NASA's program. Young said that NASA's policy is to maintain income capability, rather than "make thick budgets."



that which contractors for the development of a single prototype will be selected. Government financing will be provided only for the initial design competition.

Flight tests of the prototype should begin about three years after completion of the competition period, with actual service possible by the end of 1970, he said.

Referring to the shakedown construction of the Mach 2.2 Concorde, Halasz noted that there are "serious questions" about present aluminum alloy alloy entry times of cruising at that speed. If the U.S. supersonic transport is designed for speeds above Mach 2, steel

and/or titanium will be required for the aircraft. He added that FAA hopes it will be permitted to use one of the first North American B-70 supersonic bombers as a testbed for practical knowledge of actual danger, since boom effects and piloting requirements.

Supervision of the entire supersonic program should be under a "staff" of two persons, according to the President through the FAA, he said. Congressional approval will be sought for the establishment of this agency, along with an indication of how far the FAA can participate actively in the program under the Federal Aviation Act, Halasz said.

## Pakistani Carrier Obtains Access Agreement From Communist China

New York—Pakistan International Airlines has reached an agreement with Communist China for flights into Canton and Shanghai, providing the first direct air access into the Red nation from the free world.

In return, Pakistan would grant the Communist Chinese an equal route to Karachi and Dhaka, the Communist North Korean, head of the Pakistan airline, said last week that the agreement had been submitted for consideration by the governments of the two countries.

Initial discussions between New Delhi and civil aviation officials of Communist China concerned only the exchange of landing rights. Details such as service timing, days and flight frequencies have not been determined.

Before the services can be started by the two countries, a great deal of preparatory work has to be done. "New Delhi said in a published statement. "A timetable date for starting the service will have to be worked out in further

discussions between the civil aviation officials of the two countries."

Pakistan International Airlines officials claim that the exchange with Communist China is based on commercial, not political, considerations. The approach to the Communist country was largely motivated by the Pakistan carrier's desire to gain a practical route to Tokyo. It has been blocked in the past by repeated British refusal of rights to Hong Kong.

Routing air service via Canton and Shanghai will enable air traffic to extend to European services to the Far East and will provide the Eastern service from that part of the world to Tokyo, New Delhi said.

The airline would use its present three Boeing 720s. Six to six new aircraft flying from Dhaka to Canton in 4 hr. Dhaka to Shanghai 4 hr. 45 min., and Shanghai to Tokyo 2 hr. 15 min.

The Communist Chinese airline, operated by the Civil Aviation Administration of China, would use Sukhoi Su-70s (118) for long-range flights to the Karachi-Dhaka service. Under terms of the deal, the Russian airline, the sole carrier capable of serving Communist China is provided by North Korea.

With extension of service to Tokyo, and with plans to increase transatlantic frequencies in 1969 from two to four weekly, Pakistan International Airlines may have to obtain new aircraft, most likely Boeing jets. With four weekly frequencies between London and Karachi, seven a week between Dhaka and London weekly. Karachi-Dhaka, the airline is already flying its jets an average of 8 1/2 days.

Officials of the airline say that they would anticipate an difficulty in obtaining aircraft from U.S. or Soviet airlines. The airline is, in fact, they say, having offered a non-refundable profit consistently since 1958.

## CAB Rejects Merger

Washington—Civil Aeronautics Board has now rejected a bill sponsored by a 3 to 2 vote the request to accept the dramatic question of American Airlines and Eastern to merge.

The Board said on June 20 that its decision does not affect the request to merge the business operations of the two carriers, and pointed out that this request was subject to presidential approval. But the statement was not considered significant since Eastern's status can be used as the economic advantage of merging domestic operations.

Board members Whitney Gilchrist and Chas. Gurney dissented from the majority, which was composed of Chairman Allen S. Ford, Vice Chairman Robert F. Mapple and Member G. Joseph Maestri.

CAB Executive Ralph L. White recommended last November that the merger be rejected, and the Justice Dept. has opposed it.

In his 10-page decision White said the merger would give the combined carrier control over one-third of all domestic traffic and seems to "take it off American passengers." He added that a retail monopoly would be created in the New England area, jeopardizing the interests of Northeast Airlines.

## ASTA Criticizes Boost In International Fares

New York—President of the American Society of Travel Agents (ASTA) last week charged the International Air Transport Association with disregarding the traveling public's welfare in increasing international air fares.

Milton A. Marks said in an address here that ASTA's move inhibits the basic marketing formula which calls for a lowering of fares to broaden a market.

"To raise fares at a time when land facilities are a major problem is to substitute the present method and to substitute another, a proposal that the existing individual transfer be made to put the price of the airline industry's overcapacity," Marks said.

He criticized ASTA for repeatedly refusing ASTA's right to address the association's sole membership.

"Scraming whipped up by its own panic would of internal difficulties, IATA has apparently ignored the actual fact that air transportation is only one element in the travel picture."

It is almost true, he said, that some people believe they are not travel agents. They are transportation experts. Many of our members' problems could be solved by better understanding there is travel problems, not merely as transportation problems, he added.

## Major U. S. Airports—Part 2:

# San Francisco Airport Expansion Started

By Robert H. Cook

San Francisco's International Terminal Airport, located only 12 mi. from the heart of the city, is expanding its geographical, administrative and financial scope in a construction program designed to double its capacity by the end of the year.

During 1969 San Francisco has the airport now occupies 2,150 acres, with an additional 3,000 acres to be added and now held for future expansion. Long range plans call for construction of a third terminal building, a 1,000-car parking garage in the center of the terminal complex, and a massive level 80 project to provide space for general aviation and cargo facilities and runway extensions for the supersonic transport.

## Airport Traffic

Closely proximity to the city, along with out-of-the-way landing approaches are particularly favorable for transoceanic cargo flights which require low altitudes. 90% of the airport's traffic volume is at low altitudes and used in large percentages provide ideal take off conditions for maximum payload, long range between flights.

Expanding new industries within the 110-mi. radius here now have been largely responsible for a 200% growth in airport traffic during the past decade. Passenger volume increased 11% last year, doubling the report in the past five years of fourth largest air hub in the U.S.

San Mateo County, site of the airport has enjoyed one of the highest rates of industrial growth in the bay area and now, towards which calls for a lowering of fares to broaden a market.

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**AERIAL VIEW OF SAN FRANCISCO** International Airport shows steadily completed 1,770 ft. level 80 air runway 28,188 which will allow extension of the runway to 5,700 ft. Future plans call for addition of at least 2,000 ft. to all existing runways. Kestonville built left of the present field and horseshoe-shaped airplane taxi will be filled by B-70 as model of future terminal and parking facilities, including present terminal, control, and terminal new under construction and a north terminal. Garage will handle 5,000 cars.



able within San Mateo County, and numbered property taxes paid by both the airport and county amounted to approximately \$1.2 million last year, with more than 75% of the airline service provided by taxpayer airport. The volume of jet operations has forced most of the general aviation operations since the late 1950s the old Cleveland airport.

county's jet equipment program over the past five years. Foreign volume has dropped from 1.6 million in fiscal 1967 to 5.7 million last year, with more than 75% of the airline service provided by taxpayer airport. The volume of jet operations has forced most of the general aviation operations since the late 1950s the old Cleveland airport.



**TWIN-TURBINE OVERLOOK** is new Boeing. Vertical aerial transport helicopter now in operation with U.S. Army. Capable of carrying 50 fully equipped troops plus troop commander, its 24 fuel tanks and 100-hp turbine engines give it a top speed of 160 mph. Cabin is 30 feet long, has rear loading ramp which can be

left open in flight for carrying larger loads, or its slanting tops or supplies. Whomans payload is more than aerial loss. The helicopter's sealed fuselage makes water landings possible. Chinooks can also serve as "long cranes" carrying essential loads by means of cargohooks installed on the bottom of the fuselage.

## Capability has many faces at Boeing



**HYDROPOD**, big craft, designed and built by Boeing for U.S. Navy, is prepositioned, from hull level designed in last light-hull system as specific to 115 mph.



**PLANETARY LANDING** operator, built by Boeing, permits precise "landings" on planets. Television camera pictures relayed from 10 square feet of area in surface. Pilot's command, controlled by computer, maneuvers camera around target location. Transmitted "Autocue" for landing.



**SUPERSONIC** aircraft design, under study at Boeing, where continuing advanced aerial speed in supersonic jet (intercontinental) aircraft in long range. Supersonic jet would fly two to three times speed of sound, make flight from New York to London in under three hours.

**BOEING** has developed a series of aircraft, including the Boeing 707, 720, 737, 747, 767, 777, 787, 797, 800, 810, 820, 830, 840, 850, 860, 870, 880, 890, 900, 910, 920, 930, 940, 950, 960, 970, 980, 990, 1000, 1010, 1020, 1030, 1040, 1050, 1060, 1070, 1080, 1090, 1100, 1110, 1120, 1130, 1140, 1150, 1160, 1170, 1180, 1190, 1200, 1210, 1220, 1230, 1240, 1250, 1260, 1270, 1280, 1290, 1300, 1310, 1320, 1330, 1340, 1350, 1360, 1370, 1380, 1390, 1400, 1410, 1420, 1430, 1440, 1450, 1460, 1470, 1480, 1490, 1500, 1510, 1520, 1530, 1540, 1550, 1560, 1570, 1580, 1590, 1600, 1610, 1620, 1630, 1640, 1650, 1660, 1670, 1680, 1690, 1700, 1710, 1720, 1730, 1740, 1750, 1760, 1770, 1780, 1790, 1800, 1810, 1820, 1830, 1840, 1850, 1860, 1870, 1880, 1890, 1900, 1910, 1920, 1930, 1940, 1950, 1960, 1970, 1980, 1990, 2000, 2010, 2020, 2030, 2040, 2050, 2060, 2070, 2080, 2090, 2100, 2110, 2120, 2130, 2140, 2150, 2160, 2170, 2180, 2190, 2200, 2210, 2220, 2230, 2240, 2250, 2260, 2270, 2280, 2290, 2300, 2310, 2320, 2330, 2340, 2350, 2360, 2370, 2380, 2390, 2400, 2410, 2420, 2430, 2440, 2450, 2460, 2470, 2480, 2490, 2500, 2510, 2520, 2530, 2540, 2550, 2560, 2570, 2580, 2590, 2600, 2610, 2620, 2630, 2640, 2650, 2660, 2670, 2680, 2690, 2700, 2710, 2720, 2730, 2740, 2750, 2760, 2770, 2780, 2790, 2800, 2810, 2820, 2830, 2840, 2850, 2860, 2870, 2880, 2890, 2900, 2910, 2920, 2930, 2940, 2950, 2960, 2970, 2980, 2990, 3000, 3010, 3020, 3030, 3040, 3050, 3060, 3070, 3080, 3090, 3100, 3110, 3120, 3130, 3140, 3150, 3160, 3170, 3180, 3190, 3200, 3210, 3220, 3230, 3240, 3250, 3260, 3270, 3280, 3290, 3300, 3310, 3320, 3330, 3340, 3350, 3360, 3370, 3380, 3390, 3400, 3410, 3420, 3430, 3440, 3450, 3460, 3470, 3480, 3490, 3500, 3510, 3520, 3530, 3540, 3550, 3560, 3570, 3580, 3590, 3600, 3610, 3620, 3630, 3640, 3650, 3660, 3670, 3680, 3690, 3700, 3710, 3720, 3730, 3740, 3750, 3760, 3770, 3780, 3790, 3800, 3810, 3820, 3830, 3840, 3850, 3860, 3870, 3880, 3890, 3900, 3910, 3920, 3930, 3940, 3950, 3960, 3970, 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have desert. When certain members of the Capital Hill crowd of the space got word of what was going on there was hell to pay, on the air.

It might be worth noting that the group behind the loudest screaming from individuals who are either non-regulation or can't fly at all.

The top question who has been bagged for control over foreign space for 20 years flew into the super launch of power. The silent shot has evidently in which major programs called from with their fingers for not using power they had already asked to give him.

In the long run the European group will suffer most. Glances are they will be forced to juggle a lot more than usual. Only the Canadian space group, and its independent electronic order book who can trade instead of now, have been able to sit on the fence and laugh.

The poor European group are being picked by major agencies as the bad apples. The head of the major moved against them. This was the inclusion out of all, because all group are supposed to be committed to send off other heads who want to regulate. The Europeans were not enough to resist as being called power-law-controlled, individual and sufficient.

#### Indignant Italian

The Italian group a particularly arrogant. The Italian government has threatened an open court for both of all causes for 1,800 cases. The big American blue group, as well as the big American red group, is as low to come and go as soon as the European lines who guided Elizabeth Taylor to Helen Hayes. As for Italy, Italy has a word to say.

The Italian group has always had to struggle for its own sake. If it's so obvious, how come it's there had enough time to carry how through the world?



These birds in the air are the birds.

There are two words to this tale. When you get together they are bound to give a few tips. It's not like that dry for a piece—even as American groups, but especially a European group—in become a more than when they become failures.

## FAA Considers Lower Small Field Minimums

Washington—Federal Aviation Agency officials now hope that lower weather minimums could be attained at smaller airports during a recent Air Transport Assn. symposium here.

FAA spokesmen and significant groups have been made in developing two low cost instrument landing systems expected to sell for about one third the cost of today's more sophisticated ILS. Testing of the units, produced by Avionics Instruments Laboratories, Inc., and Scarsville Laboratories, Inc., is scheduled for this fall. Decisions on the \$276,800 price of today's units has been related primarily by reducing power requirements from 200 to 11 w, and eliminating the voice channel from the localizer unit.

Local service airline spokesmen said that inability to complete schedules at such small, remote airports during poor weather conditions, because of FAA-imposed landing and takeoff restrictions, has caused a heavy loss of revenue. In fact, the airports can not afford many of the expensive landing aids required by the FAA for certification. One airline study indicated that last January, eight airlines were forced to cancel or oversize 1,170 landings scheduled for 151 small airports because of the high ceiling and visibility requirements set by FAA. Reducing these minimums to a 100 ft. altitude and 1 mi. visibility would have cut this cancellation rate at least, the critics estimated.

FAA also reported that it intends to give greater credit to visual aids in establishing weather minimums at airports served by VOR (very high frequency omnirange), terminal VOR and ILS facilities units. A segment of a new draft on landing minimums now being circulated through the industry, will approve a ceiling minimum of 100 ft and visibility range of one 1 mi where the airport is equipped with a standard approach light system, codeless beacons and high-intensity runway lights.

FAA expenditures for the purchase and installation of navigational aids also have made reference to ATN's message for navigation, S. B. Pasteris. Comparing costs, Pasteris noted that the state of Nebraska bought a TVOR, built to FAA standards, and installed it at a cost of only \$203,000. The same type unit, installed by FAA in Seattle, Washington, cost a total materials and construction cost of \$54,000. In a new letter, he noted the state of Minnesota bought dual VORs in both airports costing only \$10,000 as compared with FAA's loading cost of \$57,000 to house one TVOR.



What 1.5 mc recorder has two signal-to-noise ratios?

AMPX FR-1400

Take your peak signal to noise ratio of 20 db or over 30 db. Ampex meets 20 db. Measured performance improves and is to be used as better. But these figures are meaningless without knowledge of the framework within which they are derived. Ampex performance signal to noise ratio by recording a 1 kHz test tone at 1 volt with the recorder set to give 1% maximum distortion over a bandwidth of 400 cps to 1.5 mc. Among other tests to measure signal to noise ratio, one is to determine a square wave at peak signal level, measured this way the FR-1400 has a signal to noise ratio in excess of 30 db. Ampex prefers the



side note. It's harder to record and give a true measure of signal performance. That's Ampex policy. All Ampex specifications represent maximum performance. And, too, all represent the correct relationship of one function to another as they exist upon one another. This is also true in those new areas of specification necessary to evaluate wide bandwidth recorders: envelope delay, phase response, reproduction distortion products. For information on Ampex's measuring techniques write for the Ampex Technical Information Bulletin Series. Ampex Corporation, Redwood City, California. Worldwide sales and service.



**NORTHROP X-21 LAMINAR FLOW CONTROL** research aircraft takes off on a test flight from Edwards AFB, Calif. Wing pod contains suction components which draw air from the wing surface through slots to smooth turbulent flow over the wing.

## X-21 Tests Laminar Flow Control Theory

By C. M. Flotten

Los Angeles—Scientists of designing a laminar flow control (LFC) system onto an aircraft wing has been borne out by actual test flights of the Northrop X-21A and the company's X-21B. These are studying possible applications of the system.

Most promising applications, according to Northrop, is the proposed CX-4 long-range turboprop transport, which is being considered as a follow-on to the Douglas C-119.

Although no firm CX-4 program currently exists, Military Air Transport Service (MATS) is known to be engineering development and several manufacturers are conducting in-house studies of the aircraft. At least two Boeing and Douglas have built mockups of their proposals.

Acquisition of the X-21A was established by a series of test flights from Edwards AFB, Calif., and full laminar flow over the outboard sections of the wings was achieved on the fifth flight of the X-21A. There was no indication during the flight that some laminar flow also existed on the inner portions of the main wing.

Northrop experts now are working on refining the system and finalizing the concept. Flight test programs, which began in June, will continue through October at Edwards AFB and will include about 300 hr. of flight time.

Follow-on test programs, which will be conducted under increasing Air Force supervision, have not been defined, but program officials are con-

scient of handling through Fiscal 1965. Northrop's participation in the program will decline as the Air Force assumes a greater role.

Range of additional testing and the possible use of additional aircraft will depend in part on results of the current test program.

If the LFC system is to be used on the CX-4, Northrop engineers say, it would be most efficient to design the system into the aircraft from the start, rather than modify it at some later time. This extremely long range for which the CX-4 would be used would make use of the LFC in many practical, since LFC benefits in a way to get more miles per pound of fuel.

This advantage can be converted

either into extended range or savings in weight because less power is needed at cruise altitude.

Northrop studies have indicated that using a supercritical CX-4 configuration with a 71 ft. dia. fuselage and Pratt & Whitney JT1D-8A engines, power requirements could be reduced by approximately 30-40% if the LFC system were used. Additional propellers might have to be used for takeoff, since the LFC's power application would be in the cruise portion of the aircraft's flight.

Use of the LFC system on a multi-purpose aircraft, such as the Dept. of Defense has been encouraging the service to study, does not appear promising at present. LFC's system use is for specific speed ranges at higher altitudes and is not effective at low altitudes. Some of the projected missions of the multi-purpose aircraft would require low-level operations, such as logistics, reconnaissance, and surveillance.

Possibility of the LFC system being used on the Lockheed C-141 turboprop transport, scheduled to fly this summer, has been brought up, but Northrop engineers believe that there is no basis for the system on the aircraft at this point, since the C-141 already exceeds range requirements.

Unless longer range requirements are generated, installation of the LFC system in the C-141 would not prove economical, they say.

Separate transport applications for LFC seem relegated to second-generation aircraft, based on current reference

shown by the Federal Aviation Agency, FAA has tested during a proposal by Northrop that an LFC aircraft and development program be undertaken similar to that accorded in engine development programs. Without such a program, Northrop officials feel that laminar flow control cannot be carried out for first generation supersonic transports.

Current LFC program is built around two Douglas WB-66D weather reconnaissance aircraft converted to X-21A research vehicles (AW Aug. 29, 1960, p. 32). Aeromedical Systems Div. of USAF's Systems Command is funding and management authority. Original letter contract was issued in June, 1960, based on an unsolicited proposal from Northrop Div. of Northrop. Estimated cost at that time was \$1.7 million, which grew to an actual cost of approximately \$15 million over the five-year development period. This was due in part to unexpected major aircraft configuration changes, including installing new engines on pilot mounts on the aft fuselage.

In addition, Northrop received two \$1-million basic research contracts from FAA in March 1963 and 1964 to study the feasibility of applying LFC to subsonic transport aircraft and to study supersonic LFC wing configurations swept ahead of and behind the Mach cone.

In developing the LFC system, Northrop chose to call its boundary layer suction system a laminar flow control system to distinguish it from boundary layer control. Boundary layer control, generally achieved by separation from a wing surface by blowing compressed air over wing leading edge or trailing edge of flap. LFC system, on the other hand, removes air from the surface of the wing by sucking it through numerous slots and ducts leading to pumping nozzles mounted on the wing.

A boundary layer is formed as air passing over a surface is retarded due to viscosity effects. Velocity of air within the boundary layer varies with height above the surface, from zero velocity at the surface to free stream velocity at varying heights depending on whether flow is laminar or turbulent. Laminar flow is a smooth flow, free of turbulence.

Straight wing laminar flow airfoils, longused in the aircraft industry, go out with laminar flow control. They are designed so that laminar or smooth boundary layer flow extends aft of the leading edge in appreciable distance before transition to turbulent flow occurs. Transition, which occurs in most high performance, transport aircraft at or near the leading edge, is the change from smooth flow within the boundary layer to turbulent flow. It is



**HEAD-ON VIEW** of the X-21 during engine ramp before flight shows placement of suction compressor pods and aft-mounted engine. Note slotted nacelle louvers on wing.



**REAR VIEW OF THE AIRCRAFT** shows suction pod exhaust ducts and engine pods. Note speed bridle which are extended and have been modified to fit around engine nacelles. Below, rear view of compressor pod shows high pressure compressor. Projection at front of pod is ram air door housing.





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**DOUGLAS**  **AIRCRAFT DIVISION**



e. Guidance? *here*. Propulsion? *here*. Space vehicle requirements? *here*. Bioastronautics? *here*. Automatic checkout? *here*. Everybody *here*?  
*Yes. Including the Systems Managers.*



Before and during World War II, the work of a military designer ended with the bare vehicle—the airplane, tank, ship, submarine, etc. When a “stocked” model had been produced, then its accessories—cannon, machine guns, ground equipment—were added by other designers much as optional equipment is added to a car.

But as the United States progressed first into the atomic age and then into the space age, system requirements arose for huge, intricate, ingeniously arranged machines capable of carrying out fully automatic missions in strange new environments. The job of designing, engineering, producing, and testing a single weapon or space system thus became one of integrating all of the system's innumerable elements at the same time and ensuring that they all work harmoniously toward the same final goal.

The systems approach to engineering has worked profound changes in industry and management. Whole jobs are rarely given to single contractors. More often they are distributed among hundreds and even thousands of con-

panies who are stacked in giant, multi-layered pyramids crowned by one or more prime contractors and an assortment of government, military, and industrial managers. Systems management actually occurs at all layers of the pyramid structure, reaching its greatest level of sophistication at the peak.

An aerospace systems manager is an entirely new kind of executive in the world's biggest business. His knowledge must bridge many arts and sciences. He must master detail without ever losing sight of the big picture. He synthesizes many elements of varying complexity, function, and geographic origin into a single massive entity that must perform with split-second precision. He controls the constantly shifting interaction and trade-offs between time, cost, and performance.

The new science of systems management and engineering is a testament to man's intellectual growth and an indispensable tool for speeding the instruments of our survival and mastery of space.

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totically minded, MEC has shipped over 4,000 metal ceramic traveling wave tubes in just 3 years. Our repair and repair rate has been so low that we're just about closed the replacement market for ourselves.

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cosine the turbulence effect of the surface roughness.

Encouraged by the results of the 1-94 test program Northrop began studying the installation of a complete laminar flow system on a large wing aircraft and eventually, we awarded the X-33 contract. WB-66D aircraft were chosen because:

- They were available in the Air Force inventory.
- The leading edge retained its the leading edge.
- Size of the aircraft would be close parallel to current transport-type aircraft and wing would be capable of high Reynolds number (40 million) flow at Mach 50 at altitudes between 24,500 and 40,000 ft.

Test results of the X-33 development program were devoted to aerodynamic studies. Major considerations included:

- Installation of engine on aft take-off/landing pylons and installation of suction tubes pumps in wing nacelles. This outlet from early plans reduced the mass effect of wing-mounted jet pumps and simplified ducting system. Original proposal called for installation of pumps in aft fuelage. Noise effect as well as turbulent air and surface roughness caused by legs or other foreign material on wing surface all lead to noise transition in the boundary layer.

- New engine was installed to achieve a more favorable thrust to weight ratio. Two 3,400-hp-thrust General Electric YF79-15 engines displaced the 5,750 lb-thrust Allison J71-A9 engines. J71s weighed 4,212 lb each including 100 lb of stores such as a fuselage ejector seats and variable nozzles which would have been removed anyway. The new engine with 2,150 lb each for the J71 engines in installed. Weight saved by installation of different engines resulted in some gross weight of X-33A before and after installation of J71s in place.

- Heavy plug was installed in engine inlet to keep noise disturbances, due to compressor where flow entering the wing surface. Plug is effectively shaped and sized to absorb and lift on a red jet pattern by aerodynamic forces. When aircraft positioned near exit entrance air flow through the smaller opening is near sonic and noise generated downstream can not travel upstream. Noise-plug is used to position the plug in flight and noise level upstream of the engine due to compressor where has been completely eliminated. The plug does not otherwise affect airflow into engine.

- Airframe-wing fittings were installed since the wing was added to the fuselage, to provide fitting of a smooth low-wing airplane in no effort to improve the local pressure distribution of the wing roots. The glass fiber fitting on



SECTION OF THE X-33's WING shows typical box construction in the fuel tank area. Tramples between the outer cases from 11 to 2 in. in height. Top skin is .015 aluminum. Below is a layer of thermal insulation (responder) between pressure chambers. Below that is a second skin which contains venting holes for fuel air. Bottom skin also is sandwich construction.

the top of the leading spar was a constant contour for bleed air lines from the engine to the low pressure section pump. Scuffler side bumps with the general appearance of an air foil on the side of the aircraft under lower wing surface, also are designed to facilitate effect wing pressure in that way. The transition of the top leading fitting further is limited to access hatches.

The new wing designed by Northrop for the X-33 is to be the most intricate of the aircraft modifications. Detailed in the new wing is the company's laminar flow control system which is general aerospace engineering review since no precedent existed for building a laminar flow wing.

It was determined that the wing should provide the laminar flow control from 24,500 ft to 40,000 ft and eventually 45,000 ft, if the vehicle carried an extended. Design came March 1994 at 58 ft at 40,000 ft would simulate high Reynolds numbers experienced in transport mode. Wing Wing area was increased 60% over that of the B-66 to provide a wing which is about two-thirds smaller in size, weight and half of chord area of a large commercial jet transport. The wing lift coefficient was set at 3.0.

Capable to integrate laminar flow at lower altitudes resulted in a design which was approximately twice the lift surface area. When the aircraft was set up, 900 in. variation in depth over a 10 ft span. Local roughness spots were held to .005 in. in depth and the gap tolerance or maximum clearance where panel joined together was held to no more than .004 in. and .003 in. when panel was out of the stream and when panel protruded into turbulent boundary. Exacting also gap tolerance led to holding wing from outside in, rather than on ventral inside nose construction.

Highlights in the fabrication of a typical outer section wing panel include:

• Build up outer skin. To a build up

effects. It was desired to have a rapid decision in terms of the leading edge leading out to the mid-chord region (with local velocities about Mach 1.0) with a gradual build-up of pressure toward the trailing edge.

To maintain a level section lift coefficient constant over the length of the span it was necessary to twist the leading edge of the wing upward approximately 4 deg. on the subsonic section and to contour the tip. Wing thickness was also used to meet need to maintain constant lift area but could not completely accommodate desired lift.

With the general configuration of the wing established, some defined the pressure distribution over the wing through a series of equations programmed into an IBM 7090 computer.

In testing for wing fabrication (AW Feb 11, p. 50), Northrop used the computer to define intermediate pressure points and milling was subsequently accomplished with punched cards.

Building fixtures were machined in several methods from aluminum plates to provide molds for building up wing panels. A total of 16 building fixtures were required to define the wing.

Original smoothness tolerances established for the center surface wing for exceeded that of unsatisfactory of conventional jet aircraft. Waxwood latencies was set up .002 in. variation in depth over a 10 ft span. Local roughness spots were held to .005 in. in depth and the gap tolerance or maximum clearance where panel joined together was held to no more than .004 in. and .003 in. when panel was out of the stream and when panel protruded into turbulent boundary. Exacting also gap tolerance led to holding wing from outside in, rather than on ventral inside nose construction.

Highlights in the fabrication of a typical outer section wing panel include:

- Build up outer skin. To a build up

of quartz-rich chondrites homogeneously dispersed in between 940 and 951 777178. All chondrites are added a layer of 100 to 150  $\mu$ m AF-33 film adhesive. The adhesive manufacturer specifies for Novebor by Minnesota Mining and Manufacturing is called to promote the plasma chamber located directly beneath the plasma slots. Plasma chambers are 8-in. wide and approximately 127-in. deep. Electrodes are drilled through the film at a 4-in. interval. The electrodes are located on the side of the plasma chamber, with slots heated directly over the center of the plasma, anodes anodes is provided along outer zone width.

After adhesives are applied and holes drilled, in order sheets of aluminum are added to complete the outer skin. After application of a bonding adhesive, each skin is attached at a pressure of 70 psi, and the bonding dies at 150 psi push the skins into the holes. The outer skin is prepared for attaching the inner skin which also serves as the inner oil well. Stringers are both T and leading rope and equally alternated.

- Skirts are drilled on a special rig (shown next to drill holes and end pieces) and are attached to the hull with a self-perforated double shear skin. Skirt and pencil's new blades are used at 10 to 50 psi to reduce friction effects. Widths of skirts is held to  $\pm .0005$  in tolerances and must fit from .0025 to .004 in, although for a given panel with roomy tolerances (to .001 in) they can be designed by Dyna-Sustain, Inc., Torrance, Calif.

Plates are bordered in choosing acid to protect freshly milled surface. Tributary faults are then bonded to under surface of outer disc. Tributary faults are flat, instead of plane and vary in length from 1 to 5 in. Their purpose is to hold the ore from a number of beds, from the planet chamber into the vein as they lead leading to the surface zone. They have places which are broken in 1 or 2 in. and are used generally to interfere in decrease the amount of rock along the length of a given disc to connect the wall changes in lead systems which can not be compensated for by the disc alone.

- Inner skin is fabricated from honeycomb and two aluminum sheets and then covered by the stronger composite: a typical upper or lower wing center section panel

Leading edge panels and trailing edge panels are built up using a multi-connection. With the completion of all panels of the three major portions of the wing-leading and trailing edges and center box sections—the panels are assembled in respective place in final assembly as a mating fit.

Design philosophy of building the wing from the outside in also permits in final fit assembly. The wing can

lower wing surfaces are picked outward against the contour boards and the wing spars are then moved and riveted to the wing surfaces. Spars therefore assume the shape of the wings rather than the wings taking the shape of the spars, as in conventional construction.

While the wing is in the resting position, LFC during and modulating values are satisfied. A modulating valve is constructed of glass fiber, and consists of a plate set at approximately a 45-deg angle in a square duct which can and allows to control air flow. They control air flow from the external space into the duct of the wing into the glass fiber contoured ducts leading from the terminal portions of each animal's wing duct into the venous system.

### Flow Regulation

The modulating valves, manufactured by Adco Process Products, division of General Metals Corp., Burbank, are the only method flight engineers have of varying carbon to optimize burner flow once wing is mated to aircraft. A total of 96 modulating valves are located in each wing.

Final assembly of left and right wing and attachment of struts and compressor pods precedes mating the wing to the airframe. Adapters are fitted with transfer bellows to remove air sucked through laminar flow control slots. They are attached to the wing by a grommet at the upper surface and actuated by an externally based actuating assembly on lower wing surface.

Suction system was developed for Nereis by Garrett & Research and consists of two pumps, one a low pressure pump run by bleed air from main engine and the other a turbopump which draws from the aircraft's fuel supply (AW June 5, 1962, p. 94).

The low pressure pump draws air from the upper wing surface while the high pressure pump sucks air from the remainder of the wing surface. Air, compressed by the low pressure pump, goes to a mixing chamber at the inlet to the high pressure pump.

Total thrust provided by the pumping system is such wing at Mach 50 at 25,000 ft is 390 lb, providing net additional thrust to the aircraft of 500 lb. At Mach 50 at 40,000 ft total additional thrust is 250 lb.

Wings are fitted with pressure taps along the trailing edge of the wing to indicate the extent of laminar flow to the flight engineer who monitors the taps through dual readouts.

On each wing there are 21 combination upper and lower permanent teeth located 4 in. above and below the leading edge. When laminar flow occurs a green light comes on in the flight engineer's compartment. Six tubes also are used on each wing to measure pressure distributions of both surfaces.

Primary flight test results, which are far above that calculated pressure de-

A technique known as strap-tube will be used to check pressure calibrations at other wing stations. Technique involves using a long strip of material with embedded tubes that will only be

Laminar flow has been observed in areas outboard of alarinas; fairly consistently and at one time or another in most of the areas around the alarinas. Laminar flow on outboard sculpins of wing has been mentioned in 28-day

banks and although the system is far from being optimized, LFC is already providing a data reduction during crash above 20,000 lb, which is converted into 200 to 300 spins increase in climb.

Station systems is based on prior to rollout to prevent foreign object contamination, but costs at \$0,000 lb have been performed with no trouble. When engine system was activated by

first time on fifth test flight in late May, booster flow transition was so deceptively smooth that test pilot Jeff Wells reduced power to maintain Mach 7.7 at 38,900 ft. without losing control, says all the railroad men.

### Power Reduction

Power reduction was calculated later to be about 1,500 lb of thrust. On the right, Wells was attempting to reach Mach .50 at 45,000 ft but the aircraft stalled at 100% rpm at the lower altitude and Mach number. Since that time, power has been restricted by installing tabs on the tail pipe so that the desired altitude of 45,000 ft and Mach number of .50 may be reached.

Typical landing speed for the X-21 is about 130 kt and very good lateral control and general handling characteristics are reported. A total of five people, including the pilot may be carried on test flights—two passengers directly behind pilot and two more in

The second N21A being built by Noor is scheduled to fly sometime next month. It was ordered primarily as a backup for the first aircraft but a separate test program is planned for the second aircraft having an accident with the first aircraft.

Chemical Division

[illegible]

11

11

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U.S. Army Photo

Weighing 3,150 pounds, combat-loaded, the M151 ¼-ton utility truck, with the Fruehauf-built body, has a 300 mile range and will operate from 45° below zero with special winterization equipment to 125° above. Its lightweight design and fast, airplane-like jacking give it superior air-drop capability.

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—The Key to Transportation Savings



Model on Fiat's Fair Air Show stand shows dual configuration of the G-95N VTOL, proposed submitted as the Italian entry in the upcoming NATO EMB-5 competition for V/STOL strike and reconnaissance aircraft. Six 401 engines are located in the forebay in secondary pods of three engines each. Left engine doors would be closed in horizontal flight. Two more powerplants also would be located in forebay. Rear view of the G-95N (right) shows twin turbojets for the main powerplant system plus the proposed lift-engine arrangement.

## Italians Design VTOL Fighter, Transport

G-95N VTOL, endowings telescopic transport also was configured to meet Italian air force specifications. In the present design, a cooperative venture by most major Italian aircraft firms, lift engines and the main telescopic powerplant on each wing would be located in inner nacelle unit. Aircraft also would incorporate a rear loading door. (Other Fair Air Show photos follow on succeeding pages.)



Scaled-down version of the G-95N, designated G-95A, was developed to meet specifications of the Italian air force. Note vents in a forward door arrangement for lift engines similar to that employed on Fieseler's Dornier Do 335 V-100 being tested in order to increase air flow into the powerplant pods. Rear view of the G-95A shows engine exhaust arrangement. Before air force has agreed to accept it as a VTOL, answer to the current G-91 short-range fighter. Fiat also has a license agreement for production rights in Britain's Hawker P.1127 VTOL fighter powered by the Bristol Siddeley BS15, and both designs probably will be evaluated. G-95N would be powered by two Rolls-Royce RB163 lift engines and two development-mounted General Electric J87 main powerplants.



Dumont Margo Balzac V-001 VTOL testbed against begins lift-off (left) from a prepared stand as a demonstration of its capabilities at a special Paris Air Show performance for French President Charles De Gaulle. Powered down for the aircraft's forward-mounted lift engines are in the open position to thrust air into the rotors. Climbing 10 ft from its right Rafal-Balzac RB 130 lift engines at 2,280 lb. Great each

the Balzac continues vertical ascent (center). Demonstrating good stability characteristics, the Balzac does above the three-story building as background (above). After passage of the Balzac test program is evaluation of the roll and yaw stabilization system designed for the Margo V-001 VTOL fighter. Lifted as rotors are positioned on a schedule of wings, nose and tail.

## French Balzac VTOL Testbed Takes Off Vertically, Translates to Horizontal Flight in Demonstration



Wing goes down and forward down for the RB 130s still in the open position, the Balzac begins transition from vertical to horizontal flight (left). First transition for the aircraft was made in March. Wings up but with lift engines down still open, the Balzac begins first stage of horizontal flight (center). Perceptual during normal flight requires it a 1,000-lb thrust Rafal-Balzac RB 130s. Displaces 7 inchboys



installed in the fuselage tail section. Goes down once again, the engine begins to let down for low altitude, low speed performance flight (above). During the performance, the pilot demonstrated the Balzac's handling capability plus its ability to fly laterally. Two photos of the Sikorsky/Whitcomb S-64 flying came demonstrations at Paris see pages 72-73. Other Paris photos are on pages 67, 71, 75 and 77.

## STRUCTURAL FATIGUE

....and what AVIATION ELECTRIC has done about it.

# AIRFRAME MAINTENANCE GUESSWORK ELIMINATED

It was realized, a number of years ago, that as the speed of modern aircraft increased, so did the problems associated with maintenance.

The original method of visual inspection used to be satisfactory, then, as aircraft performance improved, the number of flying hours or "calendar time limit" methods were added to the visual method. However, these procedures were not adequate for aircraft exposed to the high stresses inflicted by supersonic or near supersonic speeds. The structural condition of aircraft which have flown an identical number of air hours could vary considerably depending upon the weather, turbulence, speeds and handling experienced.

The third and definitive step in eliminating guesswork from airframe maintenance was achieved when Aviation Electric developed and produced the Registering & Meter, based upon a design approach adopted by the Canadian National Research Council. This small lightweight set, comprising an Indicator (or Injection) and Transducer, accurately



keeps a continuous cumulative record of the number and severity of G loads inflicted on an aircraft, thus providing maintenance personnel with a positive, foolproof record.

The A.E.L. Registering & Set is currently installed in all Royal Canadian Air Force F304 aircraft and is undergoing evaluation tests by other Air Forces.

The Registering & Meter, like the A.E.L. Land Navigation Set, Mechanical Ball Resolvers and Miniature Graham Variable Speed Drive was a "first" for Canada and was a direct result of one of the many diversified research programmes carried out during the past few years.

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## Rolls-Royce Displays Deflected-Thrust Pod

Fuelled installation for the Rolls-Royce Spey engine, shows direct use of the company's concept for the use of conventional powerplants in representative tests for STOL operations. Thrust can be directed up to 20° down through lateral on the nozzle. Before air thrust and side view of a deflected thrust section for the RB-103 Spey turbofan engine. Sliding door doors are also retracted automatically for takeoff and landing, then retract to permit sustained action during normal flight. Side view shows overall configuration of the test and of the limited nozzle arrangement. Engines were at the Farn Air Show.



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Write for new Product Bulletin PG-12



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## S-64 Flying Crane Shows Adaptability For Varied Loads



Sikorsky S-64 heliops proved being come demonstrated its maneuverability and load carrying capabilities at the Fleet Air Show. The demonstration helicopter was one recently delivered by Sikorsky to West Coast's West Coast Helicopters, which has a license to build the helicopter in Germany. One configuration (wing page) includes a pod for carrying cargo or troops. Photo (below) shows a night, low-altitude view (below left, facing page) the S-64 displays a new perfect front view. Other lifting configurations include an oil slugs at five and six attachment points to carry a heavy Krupp truck (above), Wing 14 (below) of oil tank to a wide (below) metal platform (right), and carrying light loads such as two oil barrels in a sling attached by two cables to the cargo hook (below). Sling can provide for quick loading or unloading under various conditions. Attachment points for loads are provided on both fuselage and landing gear for stability of load handling. Main rotor system of the S-64 has six blades and a 72 ft diameter. Powerplants are two Pratt & Whitney JT3D2A1 shaft turbine engines rated at 6,893 hp, each. Weight load is 28,750 lb.



## COPY CAT



### TAPE COPY STATION FOR ATLANTIC MISSILE RANGE

Six 1.5-mc Mincom CM 100 Recorder/Reproducers form the backbone of an extremely complex tape copy station recently delivered to the Atlantic Missile Range, through Defense Electronics, Inc., Rockville, Maryland. Set up at AMR last March, the station makes possible for the first time as many as five first-generation copies of prime data tapes in one operation. In addition to the six CM 100's, it also includes two 600-kc Mincom O 100's, two degaussers, and an advanced master alarm system policing forty-two 1.5-mc channels. The station is the result of Mincom's long experience with frequency responses of better than 1 mc—an outstanding reliability record since 1953.

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Engine-developed high-altitude rocket motor is designed for recovery and reuse. Expanded motor, which can be launched to altitudes of 40,000 mi., employs sliding projectiles wing attached to the motor body. For the first 7.5 sec. of descent, the wing would be unfolded to permit the entire motor to enter to earth as speeds directed from the ground. Experiments with the motor are scheduled soon, Dornier says.

## New Rocket, Missile Designs Shown at Paris



British Tracy Scourfield anti-tank missile, shown at left in model form, has combustion stages to be folded for storage. Wire-guided missile is being developed by British Aircraft Corp. under Ministry of Aviation contract. Scourfield Phosphor experimental missile, right, is designed for testing engines at speeds between Mach 2 and 5. Missile is powered by a rocket engine. Designated WRN 1, the missile is 6 ft. 10 in. long, 7.5 in. in diameter and has a test capacity of about 31 lb. It can also be used as a sounding rocket.

AVIATION WEEK & SPACE TECHNOLOGY, June 24, 1963

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This FLEXPRIENT conductor cable takes so little space that the manufacturer of the control instrument in which it's used is designed the equipment to include these conductors instead of two — 30% more in the same space! The FLEXPRIENT cable not only fits for interconnection approximately in half, saved assembly time, eliminated wiring errors, improved the reliability of the equipment and exceeded the customer-specified 10,000 cycles of flexing.



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mental requirements.

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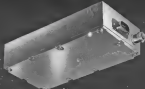


## German Concepts for VTOL, Short-Range Transports Unveiled

Focke-Wulf model of a high-wing transport at the Paris Air Show embodies proposed configuration for the FW 300 VTOL, short-range transport (above). Lift and propulsion engines would be housed in single pod along beneath each wing. Fingert design could carry 90 passengers, would have 14,000 lb. maximum gross weight and a payload of 32,500 lb. Maximum range is estimated at 1,900 mi., cruising speed at 525 mph. Earlier Focke-Wulf VTOL transport proposal, the FW 180 (left), has been redesigned to incorporate a single wing pod for both lift and main propellers. In the earlier design, engines were housed in separate pods. Larger than the FW 180, the FW 300 could carry 90 passengers over maximum range of 3,500 mi.



Manufactured also to remain in the commercial market, with a proposal for 40-50 passenger short range jet transport (below) with subsonic powerplants (pods) on either side of new four legs and a third engine housed in tail section. Aircraft would have cruise speed of 470 mi. hour. Short-range high-wing rear-loading cargo aircraft model (left) would incorporate both forward and rear loading doors and have a top level cruise speed of 285 mi. hour. External equipment adds 7,720-lb. payload is estimated at 1,575 lb., range at about 1,600 mi.



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## PRODUCTION BRIEFING

**Martin Co's Orlando Div.** will raise where the Bofors 8 mm's under a \$1.4 million buy-type contract.

**Klockner-Humboldt-Deutz (KHD)**, of Cologne, German Federal Republic, has been licensed to manufacture the General Electric T38 turboshaft engine in Cologne.

**Port & Whitney's J74** turbojet engine has been selected as a gas generator for a high-speed boost pump system aboard the first two of a new series of Royal Dutch Navy frigates. Complete contracts including the J74 will weigh 90 tons and be built by Stal-Land of Turbomeca of Stockholm, Sweden.

**Jerry Hydrodes, Ltd.**, of Montreal, Canada, has delivered the first C-341 wing spiler actuator valve to Lockheed-Gomco Co. Service contracts of engine and left-hand spiler actuators are in place. Each consists of two turbine actuator assemblies, dual input and feed-back mechanisms and a hydrodes ram-fuel with 42 valves and pistons and more than 400 cross porting holes.

University of Michigan, Ann Arbor.

will contract a \$1.5-million Spec Research Laboratory on an North Carolina Two-tones 10-000-kg fly-banking is scheduled for fall, 1964, acceptance.

**North American Aviation, Inc.**, El Segundo, Calif., has been awarded a \$1.5-million Air Force prime contract for production of modification kits, spares, and related items for Hawk Dog missiles and associated ground equipment. Work will be done in Downey, Calif.

**Thompson-Rawo Woodbridge, Inc.**, Cleveland, Ohio, has been awarded two General Electric contracts totaling more than \$5 million for rotor and front frames for the J79 jet engine powering the McDonnell F-4H F-4H and placed out production of J79 components a year ago when GE took the business into its own plant. New J79 rotor will be made of titanium instead of steel. Volume production will begin in March and reach peak volume in May.

**Western Electric Co.**, New York, N. Y., has been awarded two contracts totaling \$6.1 million for work on the Nike Zeus and Nike X automobile sys-

tems. Of the total, \$1.6 million is for additional testing of the Nike Zeus system with work to be done by Douglas Aircraft, South Norwalk, Calif., and Bell Telephone Labs, Whippany, N. J. \$2.4 million is for work on the liquid missile component of the Nike X system. Work will be done at Martin Co's Orlando, Fla., facility and Bell Telephone Labs.

**Lockheed Aircraft Corp.**, Burbank, Calif., has a \$4-million Air Force contract for maintenance, modification, and storage of F-104C aircraft.

**General Motors Corp.**, Detroit, Mich., has been awarded a \$4-million Air Force contract for component improvement of the T56 series turbine engine. Work will be directed toward design and development of modified turbine assembly installations in Air Force and Navy aircraft.

**Port & Whitney Div.**, United Aircraft Corp., East Hartford, Conn., received a \$1.5-million supplemental agreement from the Navy to an existing contract for T33 engines for USAF.

**Grumman Aircraft Engineering Corp.**, Bethpage, N. Y., has been awarded a \$10-million contract from Bureau of Naval Weapons for OV-10A Mohawk aircraft for the Army.

## New ways to use explosive energy ...from Du Pont!

Modernization demands...explosives designed to do the job...explosives designed to withstand heat—just some of the ways to use maximum energy derived from Du Pont. These and others are described in a new 20 page booklet that tells how Du Pont engineers not only know how to get it done, but how to do it, safely and efficiently. Send for your booklet...and find the answers.

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## PROBLEMATIC RECREATIONS 176



In a certain community there are 1000 married couples. Two-thirds of the husbands who are taller than their wives are also heavier than their wives; and three-quarters of the husbands who are heavier than their wives are also taller. If there are 120 wives who are taller and heavier than their husbands, how many husbands are also taller and heavier than their wives?

**Logic Design, Digital Circuit Design, and Analog Circuit Design** Engineers are being sought by our Data Systems Division to contribute to their large scale technical data systems. Requirements for these positions include experience in high-speed design, computer systems and a computer orientation. Qualified design engineers should address a résumé to Mr. William T. Short, a personnel who gives prompt and courteous attention to all applicants.

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**DOUGLAS S-4** transport stage shell of the Saturn I launch vehicle is loaded around Aero Spaceplane Inc.'s modified B-17(PG) Stratostraker for the FAA flight tests. Reinforced sections add to these removable shells, which are craned in the plane's lower cargo hold.

## Boeing 377(PG) Undergoes Flight Tests

By Harold D. Watkins

VAN Nuys, Calif.—Boeing 377 Stratostraker, modified by Aero Spaceplane Inc., to act as transport large engine stages, engines and other space components for the National Aeronautics and Space Administration (NASA Oct. 15, p. 118) is undergoing Federal Aviation Agency flight certification tests here.

An initial short-term contract to transport the Douglas S-4 second stage of the Saturn I launch vehicle, the Rockwell P-1 engine and other NASA cargo (AW June 10, p. 38) has been awarded to Aero Spaceplane by NASA's Marshall Space Flight Center. Contract is contingent on satisfactory completion of the FAA certification tests expected by the end of this month.

Receipt of the contract, which runs through the end of July, follows more than two years of planning and construction work. Actual modifications began in January, 1967. Final configuration of the modified Stratostraker quickly assumed the aircraft's nickname, "Frigate Guppy," and resulted in the designation B-17(PG).

Modifications involved lengthening the engine fuselage and reinforcing the upper hull of the Stratostraker's figure "8" configuration. Interior dimensions previously were dictated by the open nose 40-ft-long and 18-ft-dia. size of

the S-4 stage, which is expected to be a principal NASA cargo item.

The conversion approximately tripled the volume of the original aircraft shell, resulting in a total volume of 23,590 cu. ft., according to Aero Spaceplane. That makes the Guppy the world's largest volume aircraft, the company claims.



**BREAKAWAY POINT** where B-17(PG) separates the loading stage from hydrostatic tests which permit and adjust galleys and lock holes.

Principal structural changes include:

- Floor-to-ceil height of the main compartment (fuselage frame) was increased to 21 ft. 11 in., compared with 8 ft. in the original aircraft.
- At its widest, the Guppy is 19 ft. 9 in. inside fuselage compared with 10 ft. 5 in. previously.
- The aircraft weighs 31 ft. 3 in. in overall height.

Following design engineering, first modification step was to lengthen the fuselage by the inserting of a 16-ft. 5-in. section of another Stratostraker just aft of the wing trailing edge. Flight tests followed to determine control characteristics and effect of center-of-gravity change. No significant problems were encountered.

Second major phase was the construction of a "humpback" dome over the existing fuselage structure, from just above the cockpit windows to the leading edge of the horizontal stabilizer. At this time the blower was attached over the original skin as a non-structural element.

After more 50 lb. of flying to determine aerodynamic characteristics, the inner fuselage was removed above the line where the blower meets the original fuselage—22 in. above the floor in the cockpit section of the upper hull. Inner fuselage was removed from just behind

the pilot's compartment, aft to station 984 near the tail cone, as measured on the original modified fuselage. New blower fuselage then was mated as a load-bearing structure and the fuselage was modified so it could be separated completely just aft of the wing trailing edge to permit loading of engine cases. A new "cylindrical" dome 16 in. was added to add volume over the tail.

Recesses in the new blower are 16.5-in.-thick 2124 chromalloy alloy but sections. Straps are .048-in. gage 2014 aluminum. Blower forward section also is .048 in. 2014 aluminum. Motors are 150, and rear section also is .048 in. 2014 alloy steel, an additional 503 lbs. is used in a double over bow skin.

Tying the new structure to the old and reinforcing the down-shaped line lugs required high-strength materials. Double fittings of 1-in.-thick 7075 aluminum alloy and about 1 in. long, but each fitting of the new endpiece with tension and floor beams of old structure. At the forward and rear ends, wing support struts are constructed of two C-400 tubes, each 1-in.-thick 7075, set back-to-back. These in turn are reinforced at critical points with 4-in.-thick laminated strips of 4130 chromalloy-steel sheet at the forward spar and with 5-in.-thick strips at the rear spar.

Another major structural component added to the forward support bulkhead, located just aft of the pilot compartment, at the point where the original fuselage was removed. The 7075 frame has a 12-in.-deep, 875-in.-thick web, and two 14-in.-thick, 875-in.-thick caps.

The heaviest part, all of the wing trailing edge at station 364, has existing rings of a 4-in.-deep 3175 U-channel,



**BOEING 377(PG)** is undergoing FAA flight certification tests from Van Nuys, Calif. The Frigate Guppy has been modified by lengthening the fuselage and reinforcing the upper hull of the figure "8" configuration. Note V-T fin clear plane.

which is 3 in. thick. Transverse floor beams at the fuselage joint are 8-in.-deep C-sections of 4-in.-thick 7075. Galleys between beams and mating ring is a large 1-in. thick gasket of the same material.

Joining of the two fuselage sections is accomplished with 40 hydraulic cylinders spaced around the compartment perimeter. These serve to push and retract 15 tapered guide pins, which align the sections prior to locking with 32 11-in. bolts. Exterior bolts are lightened through screen punch which rings the fuselage. Controls for the pins and bolt cylinders are located on the lower left side of the fuselage section and are controlled through an screen panel.

The result will be self-contained, a portable scaffolding for reaching the

bolt screen panels will be carried in the lower cargo hold, as will floor drains which will support the rear section of the aircraft when the panel is separated for loading and unloading.

Control cables, hydraulic lines and electrical lines are broken by quick-disconnect fittings at the separation line. Galleys for fuel section controls were removed from channels above the fuselage and instrumentation improvements Aero Spaceplane claims. Each weight of the B-17(PG) is just under 91,000 lb., compared with a weight gain of some 75,000 to 88,000 lb. for



**HAND-ON VIEW** of the modified Stratostraker shows building of framework for new, enlarged upper fuselage. Structure initially was built over original body after being lengthened 16 ft. 5 in. Note clipped propeller tips on second engines.

## The F-104 Starfighter: fastest way to discourage intruders

The F-104 is a real Mach 2 airplane—men with Side-winders on it. It can accelerate from Mach 1 to Mach 2 in record time. Slam it into a 3 G turn, it's still Mach 2. That's the kind of performance an

interceptor has to have today. In fact, the F-104 holds the official USAF time-to-intercept record.

That Vulcan 20 MM cannon is a mighty good discourager, too. Flying a Vulcan-equipped F-104 in

the ainto-air event of last year's William Tell Weap-  
one Meet, Captain Toffen, the meet winner, de-  
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son technology will be the prime element in the Mars exploration mission, he said, but it has not been established that present nuclear propulsion will work.

The technology is not available today in the field of propulsion to enable a Mars manned exploration before 1983, Chilton said. Nuclear propulsion is one possible answer, but other concepts such as electric propulsion may be necessary.

A 1973 Mars manned landing is certainly optimistic, he said, and if possible at all, would not be attainable without a crash program requiring significantly greater funding. Chilton recommended an intense research program over the next five years to establish the best means of propulsion.

The 1973 Mars exploration launch window is gaining greater consideration within NASA as a more realistic date than the earlier 1971 and 1975 time periods considered in numerous studies, according to recent opinion expressed at the conference.

#### Unalterable Period

A complicating factor involved in the 1975 launch window goal, however, is the subsequent inaccessibility of launch windows over the following 5- to 10 year period. During this period, no annual Mars landing missions are considered feasible with existing raw under consideration. Some NASA officials are worried that if a planned launch during the 1975 window did not materialize, there would be no backup window within a reasonable time period.

Studies have shown that several years after an earth orbit due to slacking against increased solar flux activity and the added propellant loss to excessive higher altitude requirements due to an unstable Mars orbit periodically side and a mission during the late 1970s and early 1980s. Studies have shown that required weight in earth orbit prior to departing on a Mars trip increases by a factor of three from the most favorable, 1971 window to the least favorable 1983 launch window. The 1985 window earth orbit weight requirements are considered roughly the equivalent of the 1975 window.

A Mars landing and exploration technically could be accomplished during the "bad years" with a breakthrough in technology, such as using fuel or partial combustion landing but carry rather than extraneous fuel. Another answer might be new propulsion concepts such as electric propulsion, which theoretically could reduce weight in earth orbit by a factor of two or three over chemical propulsion systems.

However, neither these proposals nor other schemes depending on a technological breakthrough have been accepted as feasible by NASA at the present time. NASA is taking a careful look at all



#### Centaur Model Tested in Wind Tunnel

Centaur will model at the Centaur open rocket in complete engineering tests in the 16 x 10 ft supersonic wind tunnel at National Aeronautics and Space Administration's Lewis Research Center. Tests are designed to provide data on spreading characteristics of hollow open rocket from the upper portion of the second stage of the hydrogen-liquid fueled vehicle. Built of spun backward propellers, solid apertures reaching the Centaur engine. Centaur is being developed by General Dynamics/Grumman for the NASA Apollo Lunar program.

studies depending upon significant technological breakthroughs.

Concept of crew safety, which is one of the overriding concerns in conceptual definitions of the Mars mission, is evident in two of the individual agencies being conducted within NASA is accomplishing a manned Mars landing. Concept generally supported by Marshall Space Flight Center is a cruise technique.

The concept involves two space craft one carrying the crew and an unmanned, similar craft-independently orbiting as a cargo craft. The cargo craft would be designed to accommodate the crew of the unmanned vehicle, in the event of an emergency.

Another concept supported by the Marshall Spaceflight Center involves reusable vehicles. It also involves two launch vehicles launched in earth orbit but launched at different times with crew in both. One would be a flyby spacecraft and the other would carry a Mars extraterrestrial module which would be used to land on the planet and rendezvous with the flyby spacecraft.

Over the next year, NASA will re-evaluate original guidelines set down for Mars studies in the past to determine if goals such as developing bio-scientific capabilities at establishing a 10 million lb payload in low earth orbit are appropriate. Other mission concepts will be considered and Mars effort as well as other elements of Venus and Mars ex-

ploration will be reviewed in greater detail. Such reviews could be the only manned planetary mission in the 1970s.

Manned Mars mission studies to date generally have reflected the accuracy of calculating vehicles at earth orbit, employing large Mars-class boosters. This phase has been little defined and often reusable vehicles will be studied and defined over the next year. Concept of earth orbit assembly of launch vehicles probably will require space station technology to implement the techniques and develop the systems necessary to accomplish the job.

#### Feeling Element

Pacing element of the manned Mars mission, the Mars-class booster, is considered to involve a lead time of about 10 years. If a 1975 mission was established as a goal, conceptual study of the system would have to be forced up within the next year or two.

The manned Mars mission has not been defined and the next year under and analysis of past studies, as well as preparing technological breakthroughs, could alter the current concepts considerably.

Cost of the Mars exploration program is considerable, estimated in NASA conceptual planning studies as roughly 20 billion 1967 dollars, including booster development. Private opinion among various NASA and industry spokesmen, however, is that the figure would at least be doubled.



# ROLLS-ROYCE

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Over 200 Rolls-Royce service engineers are stationed with airlines, air-forces and aircraft constructors throughout the world to give on-the-spot advice to customers. And 31 companies and airlines are engaged in the overhaul of Rolls-Royce turbine engines in 21 countries. In addition Rolls-Royce aero engine schools provide courses for the executives, pilots and engineering staffs of all customers.

■ Rolls-Royce has more civil turbine engines in service throughout the world than any other aero-engine manufacturer. ■ Over 150 airlines and 120 other operators in 60 countries have ordered these engines, while so far more than 70 customers have placed 140 re-orders covering more than 400 aircraft. ■ No other manufacturer can equal this outstanding achievement: no other can equal the world-wide service built up to support the operation of Rolls-Royce turbine engines.

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1



2



3



4



5



1. U.S.A.—a Rolls-Royce service engineer inspects the workings of an Avon turbojet in a United Air Lines Conquest.

2. The Netherlands—servicing Rolls-Royce Conquest engines on a KLM Viscount.

3. The Argentine—technical inspection of an Avon turbojet in a Conquest of Aerolineas Argentinas being equipped with a Rolls-Royce service engine.

4. Switzerland—a Rolls-Royce service engineer works in the workshop of the Avon turbojet on the SAS Conquest.

5. Japan—engine inspection of the Conquest in a Viscount of All Nippon Airways.

6. Australia—service engineers from TAA and Rolls-Royce inspecting a Conquest in the care of the RAAF Viscount aircraft.

7. Germany—Conquest engines (not being serviced) in a Luftwaffe Boeing 707.



6



7



## Anatomy of a separation system

Unidynamics has achieved extreme reliability with its latest explosive separating techniques. The basic concept involves precise charges which run the veins beneath a missile's skin—outfiring the area of separation.

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Unidynamics offers unparalleled experience in the use of chemical power for separation. A wide range of compounds has been developed... safety and timing devices, detonators, delay boosters,

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## MANAGEMENT

# Congress Plans Technical Advisory Corps

Washington—Congress appears likely to establish its own corps of scientific advisors, and representing advisory

With federal expenditures for research and development amounting from \$100 billion a year before World War 2 to \$12 billion for Fiscal 1961 and only \$15 billion for Fiscal 1962, there is widespread support for a panel in which would provide guidance and evaluation to individual members of Congress and its congressional committees in passing new laws and legislation.

Congressional legislation providing for a review of the entire U.S. scientific effort, already unanimously passed by the Senate, provides for such a scientific advisory panel. Model legislation has been introduced in the House by Rep. Glen Torgue (D-Tex.). Both measures are pending before the House Science and Astronautics Committee, of which Torgue is a second-ranking member. The chief sponsors of the Senate measure are Sen. John McClellan (D-Ark.), chairman of the Committee on Government Operations, and Sen. Hubert H. Humphrey (D-Ill.), assistant majority leader.

The McClellan-Torgue legislation would set up a 12-member Commission on Science and Technology. Eight members would be congressional appointees. Vice President Lyndon B. Johnson, in his capacity as president of the Senate, would appoint two senators and two members from private life. House Speaker John McClellan (D-Miss.) would appoint two House members and two members from private life.

The President would designate two government officials and two members from private life.

The commission would make recommendations to Congress aimed at securing utilization of the scientific and technological resources of government, private industry, non-profit research organizations, universities and other educational or technological institutions. The commission's report would also be submitted to the President.

The science advisory panel of scientific advisors, and engineering experts would guide the commission, as well as give direct guidance to Congress. The relationship of this panel to Congress would be comparable to the

relationship of the President's Science Advisory Committee to the President. The President's committee is headed by Dr. Jerome B. Wiesner, who also was one of the last. He is a special assistant to the President and director of the Office of Science and Technology, a government agency reporting to Congress.

The Administration is opposed to the McClellan-Torgue proposal on the ground that there is no need for it. Budget Bureau and National Science Foundation, which have testified for the Administration, claim that Dr. Wiesner's OST is capable of fulfilling all of the objectives of the proposed commission and its science advisory panel, including expert technical guidance to Congress.

There is also apprehension that the commission might disrupt progress and planning by the executive branch.

Members of Congress note that they have no direct access to the President's Science Advisory Committee. Since its establishment after Sputnik 1 in 1957, membership of its working group generally has been secret and still is.

Congress feels that only such inter-



## Bell Tests Compound Helicopter Configuration

Bell Model 430 being tested with 21 ft tips wings is undergoing trials at Bell Helicopter Co.'s Ft. Worth, Tex., plant as part of a study to increase conventional helicopter payloads. Tests indicate greatly increased payloads are possible when raising tail rotor and landing gear mod with the compound configuration. Bell says gross weights of nearly 4,000 lb—compared with a normal 2,800 lb on conventional vertical takeoff—have been achieved with the compound configuration during hovering maneuvers and landings. The modified helicopter, "Wing Drop," has demonstrated during vertical takeoff with a 300-lb. payload that no degradation of performance occurs in the winged configuration. Bell says.

# CAREER NEWS FROM HUGHES

## Aerospace Divisions in Culver City, California

### NEW AND CONTINUING PROGRAMS AND PROJECTS

**F119** ProCENEX Missile System  
**HAWK** Integration, Assembly and Checkout  
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**STRICOM** Synchronous Communications Satellite  
**POLARIS** Guidance  
**TOW** Anti-tank Missile  
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ADDITION TO TECHNICAL STAFF

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nations (trickle through) to Congress via Dr. Weaver as the executive branch wants to trickle through.

Passing by measure to the Senate, McCarthy explained.

"One of the basic objectives is to provide a mechanism through which individual members and committees of the Congress can obtain information which is not now available to enable them to take appropriate legislative action to establish definite federal policies in the field of science and technology. The reports and recommendations of the commission will also provide a basis for an evaluation of programs which are presently in operation as well as those which are being proposed."

The commission would make its first report in January, 1965.

The science advisory panel, which continues as a permanent body to assist Congress. A qualifications for members ship on the panel in addition to professional background, would be "the ability to communicate not only to professional scientists but to laymen."

### FINANCIAL BRIEFS

**Minerals, Inc.** had first quarter 1965 sales of \$90.6 million, a 4% increase over last quarter 1962 sales of \$77 million. First quarter net income was \$1.4 million, compared with \$2.5 million the year before—a decrease of 43%. Layoffs ship was attributed to "unavoidable necessity" to improve the company's standing in the semiconductor and TV markets.

**Aerostar Book Area Corp.** closed \$767,587—equal 35 cents per share, on first quarter 1965 sales of \$23 million. First quarter 1962 earnings totaled \$691,777, equal to 35 cents per share, on sales of \$52 million.

**Calvin Corp.** reported \$116,361 earned on sales of \$5.2 million for the first quarter 1965. First quarter figures last year showed \$165,361 earned on sales of \$5.4 million.

**E.W. Bliss Co.** showed earnings of \$749,919 on sales of \$29.9 million for the first quarter of 1965. Same quarter last year showed earnings of \$973,111 on sales of \$19.9 million. Backlog on Mar. 31 was \$64 million, compared with \$58 million on Jan. 1.

**Ryan Aeronautical Co.** had sales of \$26.9 million, with earnings of \$1.5 million—equal to 90 cents per share—for the full year of its fiscal year ended Apr. 30. For the same period ended Apr. 30, 1962, Ryan had sales of \$36.6 million with earnings of \$1.6 million, equal to 85 cents per share.

**Bushnell Corp.** reported first quarter 1965 earnings of \$1.2 million, compared with earnings of \$1.1 million for the same period last year. First quarter 1965 sales totaled \$96.1 million, compared with last year's \$89.9 million.

**Loop-Tracon-Vought** showed sales of \$79.1 million and earnings of \$1.7 million, equal to 66 cents per share, for the first quarter of 1965.

**United States Steel Corp.** had first quarter 1965 income of \$329.9 million equal to a return of 3.7% on sales of \$79.5 million. Composite figures last

year showed a net income of \$55.8 million equal to a return of 3.7% on sales of \$975.2 million.

**Lockheed Aircraft Corp.** had first quarter 1965 sales of nearly \$42.5 million with a net income of \$18.6 million, equal to \$1.36 per share. First quarter 1962 sales totaled \$39.1 million with a net income of nearly \$7.5 million, equal to \$1 per share. Order backlog was \$1.44 billion compared with \$1.42 billion last year. Aircraft accounted for \$201 million, missiles and space for \$184.9 million, and others for \$18.2 million in first quarter sales.



## Know how to pack a 2,000 lb. capacity into a 40lb. winch?

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When certain helicopter specs called for a hoist that could raise a lot of cargo at 28 ft. per minute, or—for rescue work—lift 600 lbs. at 100 ft. per minute, Breeze produced this rugged little unit in 30 working days! An industrial hoist of like capacity would weigh close to 200 lbs. This weighs only 40— and has other important features as well.

For example, in addition to being durable, smooth-operating, and virtually maintenance-proof, this Breeze unit can be shifted, while operating, to either speed range; the cable can't snarl with or without load, as reel-in and reel-out is controlled by powered rollers; and the cable itself is a non-rotating type that prevents spinning of personnel or cargo.

Creating such a special unit takes ingenuity and experience. Breeze has "off the shelf" hoists and winches that answer most requirements of airborne or G.S.R. installation. But if necessary, Breeze can design, manufacture, and test the "problem child" you need... efficiently and fast.



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## BUSINESS FLYING



SIPA ANTILope LIAISON AND BUSINESS LIGHTPLANE is powered by a Turbomeca Astorix 2 turbo-prop engine. Cooling port behind propeller feeds a pilot-cooled fuel. Top truss link automatically into the nose track located below the baggage compartment.

### Aviation Week Pilot Report:

## SIPA Seeks Military Orders for Antilope

By Herbert J. Coleman

**Paris**—SIPA 251 Antilope, a rugged, high performance, turbo-powered lightplane, will go into limited production soon with the business—military in character. First Turbomeca-powered, high level military orders in France and abroad.

Latest move in this area was demonstration of the Antilope to the Italian Air Force in Rome. The airplane was to have been built in collaboration with Franco of Milan, but the firm has dropped production plans and SIPA will continue all development as a company-financed project (AW Dec. 1, p. 17).

Gaetano Arata, SIPA president and design-chief, and the Antilope will develop depending on the extent of production. First batch of 10 will be sold direct from the SIPA plant at Suresnes (Seine).

The production version will include a few minor changes from the prototype. Armament and fuel tanks will be added with a door on the right side, replacing the present two upward hinged wings, which is preferred by the military. In addition the production version will be changed to carrying the horizontal stabilizer about 15 in. to improve control in spin recovery. Prototype has a vertical fin for the same purpose.

Arata said the sides will also be

wedged about 4 in. and considerable design effort now is going into improved landing.

The SIPA Antilope is a four-seat, low wing monoplane powered by a Turbomeca Astorix 2 turbo-prop engine delivering 550 hp. The three-bladed Rotax Propeller propeller has an available pitch which can be used for landing and banking on the wing.

The engine flows in the Astorix W-2000 Series. Turbopropeller pilot air. Vibrationless. Armed with the No. 1 prototype FWSB. At first time, the Antilope had reached its 10th hour in the development test program.

Cooling is done and instruments

two has been simplified as much as possible. Visibility is excellent and a mixed only be a two-way structural link splitting the windshield. Control sticks for pilot and co-pilot are fitted in prototype, but there will be changed to wheel controls in the production version.

Landing gear is actuated electrically by actuating a handle between the pilot's seats. Brakes are hydraulic and are controlled by a single handle mounted on the left hand side, one wheel is steered by moving the rudder pedals.

All flight instrumentation is on the pilot's panel and engine gauges are situated below the engine. Center panel is taken up by a Motorola ADP T-12 radio (except and an Avionics Pans VHF radio).

Baggage compartment is located behind the passenger seats and is accessible in flight. On the ground it is reached through a door on the left side. Capacity is 6.5 cu. ft. Main fuel tank is under the baggage compartment and is fed automatically from two fuel tanks. In an emergency, or to correct imbalance the pilot can select either tank at will.

Antilope was flown with Pierre Boncompagni SIPA development test pilot. Weather was good, despite scattered rain showers, and wind was from the west at about 10 kt.

Starting sequence is simple and involves usual sequence of master switch

on, battery on, engine master switch for automatic starting and warming the lights. Antilope light engine propeller fuel flow, green light glows when the engine has started and red light comes on for an engine start. Lights also serve to warm the fuel and the engine pump gauges. The master pump is situated for 15 sec before leaving the start switch.

Once the engine has started, it is brought up to 100% power by using the fuel levers gradually. From there on, the throttle stick at full power and speed is controlled by the pitch lever either manually or in push-button. The motor is under the fuel lever on the Pans 340 Gas turbine transport (AW Dec. 10, p. 109).

### Ground Operations

In taking the airplane in response and moving pitch can be used for landing, independently or an engine on with the hydraulic brake lever. Once closed in takeoff, the Antilope is positioned on the runway center line with brakes locked. The push-button device on the throttle was actuated and brakes released when full power was reached.

The latest method gives the Antilope excellent, good start, full performance as part of its high performance design. Antilope was noted at about 70 ft. Clearance was accomplished in a fairly easy angle with 113 ft. speed gauge about 2,500 ft. climb rate. Takeoff time about 500 ft.

During climb, cockpit was level in fairly high but Boncompagni said the prototype cabin has not been developed.

At 7,000 ft., power was reduced to 50% in a sampling of the Antilope's

handling characteristics in actual climb speeds. Controls are fairly stiff in steep turns, but this will be smoothed on the production version in a modification on the linkage mechanism.

In traffic maneuvers the Antilope is superior in light climb, maneuvering and ease to control. None has the need tendency to drop in steep turns. A pitch trim wheel is mounted on the control pedestal.

It is in the low speed stages that the Antilope handles particularly well in a climb stall with flaps and landing gear up, the airplane shows a marked tendency to stall. This fact mounted at 70 ft and after a period of gentle banking the Antilope broke off slightly on the right wing. Little altitude was lost and recovery was made almost immediately, in dropping the nose.

With full flaps and gear down, the Antilope was also loaded up. Still. This time the hook came on the left wing at 40 ft after the working period. Antilope, led to be loaded into the stall and could be done in 10 ft.

In a demonstration of a low-dive, Boncompagni dropped the gear and full flaps, set power at 28% and rolled in level of the concept turn. Result was a hands-off landing of about 1,500 ft. with turn accomplished in slight radius pattern.

Antilope seats are amphibious in nature, such as cross controls, and demonstrate an inherent stability in, covering in case of apparent cabin pressure is reduced.

In coming flight with power set at 40% the Antilope attained 210 ft. in 10 sec. The structure has been considerably backed up from the wing and power down to this time. The Antilope has been tested in a low-dive, cross controls, and

with slight of discussion after while the Antilope is an aircraft engine.

First landing was made at a fairly high speed to demonstrate the handling power of combined thrust control and hand holding. Traffic pattern was completed at 1,500 ft. descent and gear was lowered at 120 ft. after releasing full flap.

Turning on fuel at 500 ft. the Antilope ran along at 180 ft. and crossed the fence at 10 ft. At touchdown, pitch control nose padded around a gate to full thrust several, hand brake was released and the engine was stopped in less than 1,500 ft.

In another landing, with full flaps at 75 ft. thrust several nose and fuel and the Antilope was still stopped in a short distance. Boncompagni said thrust several is part of the Antilope's configuration pattern, but the engine is not allowed to use the device in flight, with it at the start of the landing flare-out.

### Sales Campaign

SIPA plans an extensive sales campaign in both North and South America, with the first efforts concentrated in the United States. One production version will have the U.S. and will be fitted with a Pratt & Whitney PT-6 at contract price. In addition, SIPA is prepared to offer available rights in a U.S. market with major funding actions from France and shipping overseas.

Another facet of the sales campaign will be demonstration in high altitude countries such as South America, Australia, and make such areas as shown in areas of underdeveloped areas.

After said considerable nature is reduced has been shown in the Antilope



SIDEVIEW OF THE ANTILope shows stabilizing fin added to lower fuselage. Fin will be removed from production aircraft and the horizontal stabilizer will be used to improve handling characteristics during spin recovery.



504



JULY 22, 1963

## MANNED SPACE FLIGHT ISSUE

• The most important development of this decade, **MANNED SPACE FLIGHT** will be the subject of the July 22, 1963 issue of **AVIATION WEEK & SPACE TECHNOLOGY**. **MANNED SPACE FLIGHT**, the major segment of the national space program, is planned at \$20 billion for a manned lunar landing. The total space budget requested for fiscal 1964 alone is a record \$7.3 billion.

**AVIATION WEEK & SPACE TECHNOLOGY** has established an unparalleled reputation for detailed coverage of technical and industry developments on the plans, operations, facilities, budgets, organization and procurement policies of the national space program. Now, a task force of editors will concentrate on both civilian and military manned space projects in an issue devoted entirely to the subject.

Theme of the issue will stress future programs from Project Apollo to manned permanent moon bases, manned orbiting space stations and interplanetary Mars and Venus flights. Editorial highlights will include:

- Major progress report on Project Apollo, its hardware and technical developments.
- Status Report on Project Gemini two-man spacecraft including joint NASA-USAF operations.
- What we learned from Project Mercury and how it built a technical foundation for future manned space flight programs.
- Technical needs of military in manned space flight, including Drya-Sear, Aerospace Plane, maneuverable reentry vehicles, inspector and surveillance satellites.
- Russian manned space flight programs and technical progress.
- New types of support operations required for large-scale manned flight including simulators, control centers, transport and assembly facilities, tracking and data transmission equipment, medical and life support.

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from 60 C to 12 KMC, power from one milliwatt to many kilowatts, impedances of 50, 75, 100, 125 ohms and parameters. Packaging options include connectors, rack mounting, strapping, potting and encapsulation.

Reflection of delay has this, increase in reliability, and extensions of delay accuracy standards are the goals of every manufacturer. Whenever high-frequency performance standards are critical, look to the pure-bred components and systems communications experience of Phelps Dodge Electronics.



Greater bend severity without loss of stability or higher ambient temperatures limit attenuation per centimeter at rates, and greater stability of maximum frequency are realized for very thin uniform cable spacing.



A 6 diameter cable delay line package used in a missile application was tapered by thin Phelps Dodge Electronics copper measuring only .001 to .002 inches thick and was used.



Designed for use in missile sheath and mounted, this delay line consists of 200 ft of 6 diameter, 50 ohm, precision, low signal, lightweight copper. It is mounted on 1/2 inch thick aluminum only built in 2.5 days.



Consisting of 1500 ft of 3/8 inch diameter 50 ohm Precision, low signal package incorporates 1000 ft of delay line, electrical stability and high reliability are offered in unit used for ground testing, aircraft carrier operations.

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## AVIONICS

### FAA Testing Extended-Range Radio Link

By Philip J. Klein

Washington — Federal Aviation Agency has started tests on the first of two new troposcatter communication facilities located near Cape Cod and San Juan, Puerto Rico, which are expected to provide reliable air-ground communications over distances more than twice the normal very high frequency (VHF) line-of-sight range.

The first project, quality VHF communication in areas previously dependent upon long reliable high frequency (HF) radio.

Airlines operating into Bermuda and Puerto Rico, such as Pan American and Eastern, are participating in tests, enabling flight crews to talk directly to New York traffic controllers. FAA air craft will be used to make quantitative measurements to determine the useful range of troposcatter for air operations.

The first of the two new stations at Barnstable, Mass., has been in service for several months, while the one near San Juan is scheduled to go on the air within 90 days. The Barnstable station on a far-flung tower extending almost due south 400-625 air. The San Juan coverage will be directed almost due north two miles.

First ground use of troposcatter technology, originally developed by the military for point-to-point service is the Aerie, was introduced by Pan American several years ago. The carrier built a small station at Barbados Island for use over the North Atlantic (AW Jan 18, 1960, p. 46).

This proved so successful that Aero-transport Radio, Inc. (Aerie), the air line's communications agency, built a station atop Mount Washington in New Hampshire and has since built five additional extended-range VHF stations along the West Coast and in the Pacific for air-ground communications. Where Aerie built ground stations to obtain controlled use of a new air channel capability, FAA has built more elaborate facilities for a more thorough investigation of optimum ground and airborne equipment design limits, operational limitations and maximum useful ranges.

Over the present flight tests are completed, probably less than two, the two stations are expected to become fully operational elements of the FAA's air communications network. If the Aerie tests show accurate ability, additional troposcatter facilities probably will be built at major gateways to the U. S., according to an FAA spokesman.

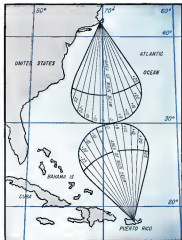
FAA has ordered its two test aircraft, a Boeing KC-119 and a Cessna 441, with standard VHF radio sets and ground equipment specially modified for troposcatter use. The airborne transmitter develops 250 w. output, compared with the usual 25 w. The receiver uses a very low noise RCA interior pentapole tube to increase sensitivity.

Side-by-side performance tests will help FAA determine whether the extra range obtained with the special equipment justifies the added expense. The agency also can flight test a special

airborne VHF area antenna being developed by Boeing which offers higher gain (performance) than a conventional VHF stub antenna.

The two troposcatter stations are equipped with high-power transmitters, rated at 4 kw, 50 times the power of conventional line-of-sight VHF units. The transmitters were supplied by Long-Term Visual's Electronics Division.

Each site is equipped with a large antenna system whose measures 164 ft high by 180 ft wide, designed and supplied by Page Communications Engineering, Inc. The antenna designed to



COVERAGE AREAS OF FAA troposcatter stations near Cape Cod and San Juan are shown in the diagram above. Airlines operating in the area may not obtain optimum radio coverage at extreme ranges under all conditions using the standard VHF equipment. FAA is evaluating the improved performance obtained with the specially modified VHF radio sets designed for troposcatter service.



Super-orbital entry of a space vehicle—one returning to earth from a planet, rather than from an earth-orbiting mission—would result in entering radiative heating in addition to the more familiar convective type. As a spacecraft now enters atmosphere, it pushes the thin air aside. A boundary layer is forced next to the skin. Ahead of that is a compressed mass of air, heating that, a shock wave. The air behind the shock wave becomes undisturbed, cools, and radiates to the heat shield. Within the boundary layer, friction heats the nose cone by convection.

Lockheed scientists believe that at higher than escape speed a blunt-nosed vehicle may be unable to sustain the radiative heating. Consequently, a vehicle like the previously discarded sharp nose is



indicated. Fluid mechanicians are calculating the heat load, determining how rapidly the nose will erode and how to keep it sharp. Current shock tube tests are providing some clues.

Another research project in Lockheed's Fluid Mechanics Laboratories relates to the flow of buoyant fluids. A typical study program is the determination of how liquid hydrogen, stored in a tank in space, stratifies. This, in turn, determines the level of pressurization required in order to extract all of the fluid. Scientists make a mathematical model of what they think occurs inside the tank. With this as a guide, an actual tank was constructed to obtain measurements and photographs of the flow to verify their theories.

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## LOCKHEED

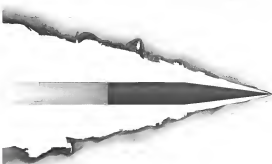
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Taming temperature extremes



withstood 180 mph winds, bursts of eight vertical cone reflector fans with tilt/deg angles each week, up to 15 tilt/deg angles.

Only one of the eight fans is used for instrumenting. The provide coverage over an angle of about 16 deg in azimuth and 4 deg in zenith, resulting, corresponding to a gain of about 51 db.

For servicing the actively work angles from azimuth all eight fans of cone reflectors are used and connected into a phased array, intended to provide an effective gain of about 15 db. In effect, the covering array operates and is automatically directed toward the aircraft such which the station is communicating.

This is accomplished by using a delay-line matrix to combine signals from each of the eight fans which are in phase so that the antenna performs as if it had one separate receiving beam, each approximately 4 deg wide in azimuth.

Collectively, these four beams cover approximately the same azimuth area as the station's transmitting antenna. These in phase signals are fed to each of nine VME receivers all of which are tied from a common automatic gain control (AGC) which enhances the output of stations operating from the strongest signals while suppressing the output of stations getting little of the signal.

As a result, usually each one of two receivers are active at any instant. As the aircraft's azimuth position changes, different receivers will become activated and deactivated automatically, according to James McLeod. Paps, in terms project engineer.

The VME receivers are standard LAA units which have been modified by Paps to operate from a common automatic gain control. The AGC serves of receiver simultaneously to provide the equivalent of loss-increasing for the receiving unit.

FAA project engineer Urban Pollack says that the Paps delay-line matrix has not yet delivered the performance which the agency hoped to achieve. Therefore, FAA plans to evaluate another type of beam-forming system designed by Radiation Systems Inc. to make comparative tests.

Because the effectiveness of target-predictor radar communications depends upon several factors, FAA hopes to commence its tests for a 12-month period, according to Pollack.

First flight tests with the Gallatin began in February, with the KC-119 entering the program in March. During the winter months, avionics engineering began as great as 500 test runs obtained. Many contacts now maintained out to distances of more than 400 nautical miles.

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A radio telescope reflecting thru signals in space, and the first grade stethoscope transmitting direct sounds, have much in common. This appears at first glance. Both represent milestones in signal amplification.

At ITT Federal Laboratories a 40-foot stethoscope, communication radio telescope is functioning as a research tool in the development of new milestones in military and commercial space communications. Built with ITT Conco, C. Incorporated, such advanced features as tracking receivers using phase locked loop detection and frequency control detection, transmitter design using solid state power supplies, receiver solid state amplifiers and modulators, and laser diode preamplifiers.

A current program involves participation with NASA in using the ITT radio telescope at Walley, N. J., for experiments with RILAY. But this is only part of the task. Walley also serves as the ground station for the first space communication link between North and South America. The terminal in Brazil is an ITT, designed and developed transportation ground station that can be installed by air in 16 hours. Similar stations are planned for Europe.

For another long-term program, ITTFL involves large-scale multiple access systems as they appear 10 years from now. ITTFL takes a total systems approach to these space communication problems, including technique and hardware development where there is a void in existing technology. Among problems receiving current emphasis are:

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New and better ways of packaging and obtaining necessary power, such as solid state supplies and solid state oscillators

Very low level beam circuitry

Methods of delaying and engineering phased array high gain directive antennas for installation on satellites, unmanned satellites

Transportable ground stations suitable for mobile support

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FEDERAL LABORATORIES

timelagging VHF facilities attempt to give periodic test calls to check signal range when operating conditions appear unusual. However, it is not feasible to make quantitative measurements such as signal levels or precise maximum range for each day. This type of data is needed for best equipment design.

Amco's analysis of qualitative data indicates that meteorological conditions give a dominating role in determining signal range on any day, according to Amco's R. S. Connel. Research using range contacts appear to result from "radio ducts" caused by temperature inversion conditions which propagate VHF signals with unusually low loss.

For example, the Amco station near San Francisco, located at 1,490 ft elevation overlooking the ocean, has experienced with flights near Honolulu on a number of occasions and at least once failed with an accident at the Honolulu airport itself. Connel says this station, using a 1 kw transmitter and an antenna providing 15 db gain, gives reliable service to 470 nmi, or 90% of the time and 50% of the time it reaches out as far as 580 to 1,200 nmi, or, current during winter.

During February, March and April maximum range can fluctuate as much as 500 to 1,800 nmi or, within a few hours, occasionally dropping to 200 nmi and in the presence of a low pres-

sure trough located along the coast. Other Amco stations are located near Seattle, Los Angeles, on Okuma and in Asia Island in Hawaii.

## West Ford Test Set For Data Technique

Technique which greatly increases the speed at which digital data can be transmitted and received without errors has been successfully demonstrated by Massachusetts Institute of Technology's Lincoln Laboratory. The transmission rate automatically adjusts itself to compensate for adverse conditions on a telephone line or radio circuit.

The technique, which has application to space communications, will be tested on the recently launched Project West Ford orbit test of laser-like pulses (AW News 20, p. 34).

The new experimental coding technique called SFCD has operated over an 800-m standard telephone line from Lincoln Laboratories in Lexington, Mass., to Syracuse, N. Y., and back. Average transmission rate was 1,500 message bits per sec, with rates up to 9,880 message bits per sec under favorable conditions compared with rates of 1,800 to 2,100 bits per sec obtained with conventional techniques according to Lincoln Laboratory.

Where conventional techniques usually result in an average of one error per min of transmission, SFCD operated for 46 hr and transmitted over a billion bits without a single message error, Lincoln Laboratory reported.

In operation, SFCD transmits an average of about 15,000 bits per sec, roughly half of which are used to carry the message while the remainder are used to check the accuracy of the received pulses. At periodic intervals, the transmitter stops to await acknowledgment from receiver that message has been received without error. If correct acknowledgment has obtained the message, transmitter automatically repeats the last portion. If error-page condition shows a long-term degradation in current atmospheric conditions, the system automatically reduces its transmission rate.

Under adverse conditions, transmission rate automatically increases.

Present maximum average tested rate of 15,000 bits per sec is limited by the capacity of telephone lines. In the scheduled West Ford experiments rates up to 9,880 bits per sec will be tested. The SFCD technique, according to Lincoln Laboratory scientists, is the first demonstration of a truly self-adjusting communication system. It should provide greater message capacity in communication circuits.



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# Engineering Opportunities at Hamilton Standard

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The water separator shown above is part of the open air loop under advanced development at Hamilton Standard. In addition to separating condensed aerosols from the air, the device, when integrated with space capable environmental control equipment, isolates condensed liquid to pump the condensate to a storage vessel.

Other problems now being studied by Hamilton Standard's life support equipment engineers include: improved cryogenic storage systems for zero-g applications, carbon dioxide removal and reduction, two-gas atmosphere pressure control systems, and rejection of metabolic products back into space habitat air. All this will require proven techniques to systems analysis and integral test in order to assure dependability and efficiency.

Dealing with these and other problems, Hamilton Standard engineers and scientists are a special breed of men. They are men capable of close working relationships, programs, men who are sensitive to close bonds with customers, men who can visualize and pursue the total program. They are men with a strong analytical bent, willing to wrestle with problems now that can lead to proposals in the years ahead. If you are this kind of man, send us your quality for any of the positions listed, and your resume to:

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**DESIGN ENGINEERS**—with background in structural design of aircraft or aircraft components. Familiarity with mechanical design of heat exchangers, rotating machinery, hydraulic and pneumatic systems. Familiarity with systems analysis involving environmental and aerothermal effects. Some experience in structural and thermodynamic analysis.

**ANALYTICAL ENGINEERS**—with experience that has emphasized analysis of systems in thermodynamic and heat transfer. Familiarity with environmental control equipment, analysis, and track of studies. Knowledge of current heat exchanger and heat exchanger design and test analysis.

**DEVELOPMENT ENGINEERS**—for initial assignments on mechanical systems involving heat exchangers, rotating machinery, hydraulic and pneumatic systems. Should have experience in developing and conducting environmental tests for ground and in performing evaluation and preparing component specifications.

for tests, manufacture, and procurement. Familiarity with thermodynamics, heat transfer, hydraulics, pneumatics and elasticity. **ADVANCED PLANNING ENGINEERS**—to conduct preliminary design and research studies, prepare and present new product technical proposals. Require knowledge of thermodynamics, heat transfer, environmental systems analysis, control dynamics, and systems. Some experience in thermal development and test analysis of engineering programs.

**TEST/RELIABILITY ENGINEERS**—with experience in structural and thermal analysis of mechanical systems involving heat exchangers, rotating machinery, hydraulic and pneumatic systems. Background in test facilities and test procedures for such systems. Profound background knowledge with techniques of reliability analysis, reliability testing, and failure analysis and experience in applying these techniques to testing system reliability goals, engineering reliability in system components and evaluating component and system development to achieve required goals.

**Hamilton Standard** DIVISION OF **United Aircraft**

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for use of intelligence between man and machine in such systems.

## (c) Analysis of Intercommunication Mechanisms

### Contractor: Planned

Additional knowledge is required regarding the physical capacity of the physical senses of man and the most efficient methods for transfer of information from man to machine and vice versa. A detailed analysis of the mechanisms employed by humans beings for information transfer will be required.

## (f) Psychophysical Effects

### Contractor: Planned

This effort involves investigation of psychophysical aspects of all man-machine events or states. Examples are control handling power at the tactile sense and flexibility studies of the recall of psychophysical status during active use of hypoxic techniques.

## (g) Biological Intercommunication

### Contractor: Planned

This work is intended to provide advanced techniques and devices for interconnecting the biological organism in order to sense, transmit, and display physiological and psychological data in support of the basic project objectives.

## TASK 416001 Biome Cybernetics Techniques

### (a) Probability State Variable (PSV) Devices

#### Contractor: Adaptation, Inc.

This effort involves a study of decision processes, and control and communications processes in act models of PSV devices in relation to requirements for learning ability of the network, object to build an autonomous path, and for problems involving a minimum of a priori information.

## (c) Crystal Color Displays

### Contractor: Canon Laboratories, South Glenside, Pa.

Feasibility studies of bleached color centers are required to obtain high-resolution three-dimensional data storage. Biological systems are thought to store up to 12 bits of information, useful for performing such functions as learning and decision. Physical analogy of such systems may be expected to require memories of a similar size eventually.

## (d) Biome Logic Theory

### Contractor: Planned

The objective here is to design a network to the machine load in human networks is required to define such networks and to use as a model of this dynamic response. The objective here is to establish a model that will be capable of modeling

both random and regular connected with.

2. New Algebra and Matrix Logic—Due to the needs in addition of devices having two stable states, and a Boolean algebra for describing their use in binary variable problems, the potential advantages of these devices and corresponding matrix algebra has been largely neglected. This effort would investigate an algebra of which has an and terms, are specific cases, and would develop a logic for general multi-state devices. Such devices appear to have potential systems which the additional states could be represented and in fact in "false" but in "true" functions of true.

3. Analogous Logic—Some changes here in a network little known and explored technique whereby an old network network is a truly time-independent node, operating successfully with out receiving periodic timing.

## (d) Control Systems Structure and Physical Analysis

### Contractor: Planned

Control and operation of biology or system consists from the control system analysis. The structure of the control system consists, is a complex, complex, but few possible ideas in the structure of physical analysis, with the capabilities. This effort is intended to provide an adequate basis of other data for the general structure of basic control system.

## TASK 416004 Biome Systems

### (a) Peripheral Access Lattice Structures

#### Contractor: Space Control, El Segundo, Calif.

This effort involves investigation of morphological lattice structures in order to determine their properties at performing selected logic functions. These devices are expected to exhibit adaptive behavior through passively applied conditioning stimuli.

## (b) Neuronal Networks

### Contractor: Adaptation, Inc.

This effort involves the study of neuronal networks to determine if them and computer simulation with regard to level and autonomous and sub-pro. (The neuron is a highly sophisticated neuron model). This will include the network simulation of a chess player, is audio sound synthesis, and a paper study of the best representation structures for neurons and the construction of one model from these studies.

## (c) Epistemic Foundations

### Contractor: Adaptation, Inc.

The purpose of this work is to

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**Senior Engineer—Tactical Weapons Systems—RS&E, NS&E, and 2 to 6 years' experience in analysis of missile dynamics, aerodynamics and structures. Individual should have a background in such areas as: missile flight controls, trajectory analysis, rigid and flexible body dynamics, aerodynamic boundary-layer analysis, fluid mechanics, and guidance and control systems analysis.**

**Staff Engineer—Fire Control Systems—6 to 8, M.S., E.E. Physics: 6 to 10 years of related experience required in computer and servo systems which are necessary to perform all fire control functions from target acquisition to tracking of weapon, including platform and platform stabilization, sensor, sighting and ranging, servo controls, communications and display.**

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develop from a small set of parameters (fundamental definitions or axioms) the basic structural concepts of machine intelligence. The process which characterizes machine intelligence (learning, perception, etc.) must then be deducible analytically from the structural model so obtained from the parameters.

#### (3) Adaptive "Sensory"

##### Contractor: Adaptions

This work element involves a search on the implementation of learning systems by the development of goal-directed systems that are able to learn their own components and concepts as necessary. Layers of discrimination, photoacoustic, and transparent conductive layers are set to sensors, conductors and other electronic components as required are utilized, together with an analysis string mechanism.

#### (4) AF System Development Into Operating Parameter

##### Contractor: Planned

It appears that multiple input and/or multiple output time sequential switching results may serve as appropriate models for systems, and that anything of a general or theoretical nature that can be determined about these results is applicable to system problems. Of fundamental importance to this effort is the understanding, interpretation, design and development of an AF system by decomposing it into its fundamental parts and isolating the significant, interrelated parameters.

#### (5) AF System Cost Structure and Analysis

##### Contractor: Planned

The primary approach to be taken is to analyze the overall mission goal structure of an Air Force operation in terms of an appropriate basic system and establish means of correlating those goals. Implicit in this approach are considerations of language, physical structure, and temporal compatibility.

#### (6) Statistical Analysis of Performance

##### Contractor: Planned

Methods of statistical mechanics will be employed to assess performance of both models of system and system that have been constructed. Parameters must be determined that will provide a capability for more rapid evaluation of basic system performance.

#### (7) Reliability of Systems Through Biomechanics

##### Contractor: Planned

Intensive reliability studies will be conducted using the laws of single component technologies and other techniques such as threshold logic and self-separable adaptive systems.

## DEFENSE CONTRACT AWARDS SECOND FISCAL QUARTER SUMMARY—1963

Now available free from AVIATION WEEK & SPACE TECHNOLOGY are summary reports of defense contract dollar awards covering the second fiscal quarter of 1963. These reports show defense dollars awarded in 179 product/system categories as compiled by Frost & Sullivan, Inc. Information is also available on the second fiscal quarter 1962; third fiscal quarter 1962; fourth fiscal quarter 1962; and first fiscal quarter 1963.

Reports are available on an individual request basis in the following system areas:

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team to build reliable systems from unreliable components.

### TASK 410077: Experimental Synthesis of Bio-Neural and Systems

#### (a) Theoretical Studies of Network Behavior

**Contractor:** Planned, to follow.  
This work should include mathematical investigation of random and regular networks with respect to signal propagation, input-output "transfer," storage effects, transient formation and propagation.

#### (b) Experimental Studies of Network Behavior

**Contractor:** Planned, to follow.  
Basic networks will be constructed and mounted under varying environmental stimuli to measure network responses to such stimuli. Both static and dynamic characteristics of these networks will be obtained.

#### (c) Multidirectional Information Transfer Techniques

**Contractor:** Planned, to follow.  
To mimic an animal network of living systems is the ability to communicate not only unidirectionally between sensor and brain and effects, respectively, on a microscopic scale, but also unidirectionally between localized networks on a macroscopic scale. Multidirectional path building techniques using three-dimensional receptive circuits will be developed as well as current experimental techniques of neural coupling.

#### (d) Associative Memories

**Contractor:** To-House, 1 in Progress, 1 Planned.  
1. Build a data processing paradigm data processing techniques that assigns a numerical address to specific neurons, locations and addressing these locations; memories may be created, addressed by comparing a word of information to all those stored in the memory simultaneously.

2. To enhance efficiency, techniques have been proposed which require information to be distributed throughout the logical structure of address rather than being a centralized memory structure. Implicit in these techniques is that the memory, rather than being finger modules, might take the form of logic and/or delay.

### TASK 410086: Experimental Adaptive and Antennasense Systems

#### (a) Active Networks

**Contractor:** Planned, to follow.  
Experimental results of the adaptive circuit behavior of a large number of Active devices will be obtained both in simulation and experimental operation of these devices.

#### (b) Optical Neuronlike Structures: Planned, to-House

This work will lead to the realization of adaptive behavior through the employment of photoconduction, cinematographic techniques and analog storage by high-speed digital circuit processing.

#### (c) Network Access Research

**Contractor:** Planned, to-House.  
Investigations of means for obtaining access to the information to sensors or actuators will be conducted utilizing such techniques as linear, nonlinear, nonreciprocal, nonlocalization (by photoconductive film) or photoconductive (glass) or analog methods.

#### (d) Tunability of Adaptive Systems

**Contractor:** To-House, 1 in Progress.  
This effort will consist of characterizing adaptive systems according to psychological and physiological attributes and reasonable constraints, classification of generation procedures and measuring a subset of the generation procedures.

#### (e) Information Coding in Living Systems and Planned Analogs

**Contractor:** To-House, 1 in Progress, 1 Planned.  
Research into the basic nature of information transfer within a living system complex has established the fact that nerve stimuli are transmitted in a pulsed rather than as analog (grayscale) mode. The nature of these pulses issued has not been fully analyzed in that the relative importance of the various forms of pulse coding (such as pulse amplitude, pulse width, and pulse position) has not, as yet, been fully explored.

However, more observations have been documented which support a theory of pulse interval coding in the transmission of nerve stimuli. Since the method of data processing (whatever its exact nature) is ineluctably most efficient in a living system, the possible reduction of the information coding process to a natural physical analogy is of considerable significance in inspiring machine data-transfer and processing methods.

Observations have been documented which show that certain particular transfer functions along nerve paths. The possibility of utilizing complex functions involving feedback loops, delay, and possible even active components without the necessity of digitalizing conversion systems transferable utilizing a pulsed interval code approach. The reduction of these concepts to physical analog relationships will require investigation of the exact nature of the data code and transfer parameters.

Also, the element structure of the data paths must be carefully analyzed in order to achieve an efficient structure of the related physical analog.

#### (f) Sequential Network Logic

**Contractor:** To-House, 1 in Progress, 1 Planned.

Combining studies in sequential network logic are required for the development of techniques which will effectively describe and store in memory elements for large sequential networks. Intuitive work is required on the problems of making optimum state reductions and state assignments at systems, that become large. This effort will serve to complement a separate study in synchronous logic, by contributing a more detailed knowledge of sequential circuits and of the effects of varying element time delays.

#### (g) Error Detection and Correcting Codes

**Contractor:** To-House, 1 in Progress, 1 Planned.

Error detection and correction techniques, depending upon the basic data code, are complicated by the requirement for special code schemes and/or redundant coding. An approach which builds on the known capabilities of biological systems to detect correct and adapt should provide for efficient error detection and correction.

### TASK 410087: Neurologic-Functional Relationships

#### (a) Relationships Between Information Mechanics and Matter Energy

**Contractor:** Planned, to-House.  
Theoretical and experimental studies of the relationships between information theory and classical thermodynamics are required to provide basic knowledge as to information transfer capacity via different media for use in future systems. This work is intended to evaluate information transfer and compare with the known relations between energy and matter.

#### (b) Biomechanical Evolution

**Contractor:** Planned, to-House.  
For better systems to ever be capable of recreating themselves, systems must be determined for evolving desired characteristics, and means for creating mutations or changes under controlled conditions must be determined.

An excellent example of this capability is known to exist in biological systems in the genes and chromosomes. Theoretical mathematical studies of number sets have revealed a means of evolving character codes in which the same principle found in living systems and show great promise in planning the designs of basic systems.

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► **Helicopter Avionics Problem**—Eight companies which submitted bids in Navy's recent HHN (Integrated helicopter avionics system) competition (AW June 10, p. 39) were Antronics, Birmingham, General Electric, International Business Machines, Minneapolis-Husarell, Northrup, Teledyne and Texas Instruments.

► **Phlox Incorporates Aeronomics**—Aeronomics Div. of Ford Motor Company will become a division of the company's Phlox Corp. effective July 1. The move is intended to improve coordination of Ford's space and defense activities, according to the company. Its recent aerodynamics research is the high altitude, reentry body and shock properties and an anti-submarine warfare activity.

► **Easy Weapon Activity**—Development of a high-energy radiation device by Rand Corp. for the Navy's Bureau of Weapons has been extended after a lapse in the program earlier this year. Effort reportedly is aimed at achieving high energy, fast beam weapons applicable to explosion of subsonic weapons.

The program is now under the supervision of the Naval Ordnance Laboratory.

► **Leor Siegler Research Shakeup**—John Berke, senior vice president of Leor Siegler, Inc., has assumed duties as acting manager of Leor Siegler Research Laboratories with the resignation of Dr. Jay Tol Thomas, director of research for the corporation. Dr. Herbert Marlow, who guided Leor Siegler from founding late last year, has been named technical director. Earl H. Blevin, previously vice president of engineering, American Motors Division, has been named manager of Microelectronics Division. Leor Siegler, who stepped during last year's acting manager of Microelectronics, according to Dave Moore, manager, who resigned earlier this year. Moore continues as a consultant to the company. Replicators for other technical personnel who recently left the company have not been named, according to a Leor Siegler spokesman.

► **Signed on the Dotted Line**—Recent major avionics contract awards include: **Control Data Corp.**, Minneapolis—a \$2.3-million contract from North American Aviation for an 84-A computer system to be used in automatic identification of Sierra 3 bomber vehicles.

► **Electronic Communication, Inc.**, 19 South Division, Tempe, AZ—\$37,750 award for a test of a self-heating phased-array antenna from Korea Air Development Center.

► **General Dynamics/Electronics-Redlands**—a \$65,400 contract for study of a magneto-acoustic conductive-pulse stand-alone system expected to provide a stand-alone rate of several magnitudes, from National Aeronautics and Space Administration.

## NEW AVIONIC PRODUCTS

► **Ultra-high speed switch, Model D511**, a SPDT solid state type, has switching speed at less than 10 nanoseconds (half-microseconds) over frequency range from 4.2 to 250 mc. Device weighs only 6 oz., measures 1 1/2 x 3 x 1 in. It can handle 250 mw. of RF power, provides more than 60 db isolation up to frequencies of 100 mc., 40 db from 100-250 mc., with 2 db impedance to screen loss. Manufacturer: Sanders Associates, Inc., 93 Canal St., Norben, N.H.

► **Phlox tube generator** provides source of variable pulses at frequencies up to 250 mc. for testing computer logic or other permitting quantitative analysis

tion of various response and recovery as a function of amplitude, frequency and pulse duration of input signal. Device



permits independent variation of timing and duration of four separate pulses. Manufacturer: Naval Research Services, Inc., 176 Greenwood Ave., Fairfield, Conn.

► **Injection laser diodes**, available in family of both coherent and non-



coherent emitter types, include gallium arsenide and emitting at 8,400 Angstroms and gallium arsenide-phosphorus diodes emitting at 6,300 to 8,400 Angstroms, depending upon ratio of arsenic and phosphorus. Laser thresholds for devices range from 1,000 to 10,000 mw/cm. Standard diodes are available in glass packages. Electro-Nuclear Laboratories, Inc., 2403 Lopham St., Mountain View, Calif.

► **Combination torque-pickoff**, for use as a pick-off and accelerometer, provides torque source and a pick-



off signal from single device. Torque output a 300 dynes/cm pick-off with loads of 15% per degree. Pick-off output at 4 v./deg. with linear

of 1% over range of 2.1 deg. of travel. Device measures 1 1/2 in. diameter. Manufacturer: Space Electronics Laboratories, Carol Neck, E. J. N.Y.

► **Electrostatic tube**, Type CK307, provides low-level amplification of re-



duced weak signals in the order of 0.01 microvolts/cm (5 x 10^-6 amp). New package draws only 0.0075 watt total power under typical operating conditions. Tube required to load on its own chassis, photo-multipplier and biological transducer probe, is 1 in. long with a cross section of 0.23 x 0.29 in. Manufacturer: Raytheon Company, Industrial Corporation Div., 55 Chapel St., Norcross, N.H., Mass.

## Problem: TAME THE BIG FLAME!

The assignment: Build and test fire America's first one million pound thrust, 156" diameter solid propellant rocket engines, with special emphasis on the use of jet tabs for thrust vectoring. Motor number one to be tested within eight months! To guide and control this Niagara of fire is the core of the vital defense project recently awarded Lockheed Propulsion Company by the Space Systems Division of the Air Force.

Boasting out of the cut cone at Mach 3 and a temperature over 3,000 degrees F, the big flame must be tamed and directed, an engineering challenge of the first magnitude.

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Engineering; Tactical Weapons Engineering; Propellant Development; Physical or Inorganic Chemistry; Chemical Engineering; Thermodynamics; Aerodynamics; Stress and Stress Analysis; Reliability Engineering.

Write: Professional Employment Office, Dept. 5006, P.O. Box 111, Redlands, California. An Equal Opportunity Employer.

F.S.—A word to the wives (husbands, too). Living is mighty pleasant in Redlands. This smog-free, friendly community, with fine schools and universities, shopping centers, etc. is only an hour and a half drive from Los Angeles, and with quick access to famed Southern California mountains, desert and beach resort areas.

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**Autonetics** 

Divisions of North American Aviation  
MAINTAINING THE FRONTIER OF ELECTRONIC FRONTIERS

## WHO'S WHERE

(Continued from page 231)

**Frank A. Maza**, staff engineer, Satellite Control Systems Office, Systems Research and Planning Div., Mission Critical, Los Angeles Calif. **Alan De Peter & Schultz** and **William C. Truitt**, staff engineers, Guidance Systems Dept., Systems Research and Planning Div.

**John B. Dinsley**, chief engineer, technical director of the Cubic Corp., San Diego, Calif.

**J. E. Brooks**, manager research and engineering, Acoustic Products, General Dynamics/Electronics, San Diego, Calif.

**Joe F. Schindler**, vice president-market mg., Polaroid Electronics Corp., Long Island City, N. Y.

**George J. Hart**, executive vice president and general manager, Cady Manufacturing Co., Chicago, Ill.

**John T. McGraw**, vice president, Rapid Instrument, Inc., Pasadena, Cal. has been named as executive vice president of the Vand Ets.

**Paul E. Burns**, a vice president, F. & M. Maltby & Co., San Diego, Calif.

**MacDonald Goodson**, vice president defense, marketing, Mod Engineering & Manufacturing Corp., with offices in Washington, D. C.

**Robert L. Denke**, vice president engineering, Miller Research Corp., Baltimore, Md., and **Robert G. Reid**, vice president-marketing.

**Ray Allen Daniel V. Galley (DSN)**, is, newly appointed to the position of, Kollsman Instrument Corp., Manhattan, N. Y.

**Albert D. Gussow**, chief engineer, San Joaquin Electronic Products, Inc., Cupertino, N. Y.

**Elmer Biddle**, general manager, Electronic Products Div., Marshall Industries, San Marcos, Calif.

**Charles L. Winchester**, public affairs vice president, Intel-McDonough, Inc., San Carlos, Calif.

**Robert W. Goodbridge**, corporate staff engineer, Acoustic Electronics, New York, N. Y., and **Charles L. Koller**, manager, Contracts Administration.

**Donald B. Brown**, public relations manager, New American Co., San Diego, Calif.

**A. Chelley**, director of field engineering, Mechanical Controls and Guidance Div. of Telecommunications Corp., Los Angeles, Calif.

**Robert B. McKinley**, vice president finance and administration, Sperry Gyro Corp., Allentown, Calif., a subsidiary of Sperry Corp.

**Warren B. Olfert** and **George J. Yonemura**, appointed technical assistants to the president of Autonetics Industries Laboratory (AID) Division of North American Aviation.

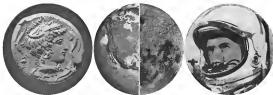
**Don Paul N. Y.**

**E. Jack Lankford**, manager of quality assurance for American Machine and Foundry Co. has been elected president of the American Society for Quality Control.

**Dr. A. V. Fogelbaum**, manager of manufacturing operations and quality control for General Electric Co., new board chairman of the Society.

**Ward B. Deems**, corporate vice president development planning, Nurtling Corp., Beverly Hills, Calif.

## GENERAL ELECTRIC ENGINEERING OPPORTUNITIES



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"The requirement for the Integration and Checkout program arises from the unique characteristics of Apollo which distinguishes it from other projects. These include (1) the serious consequences of failure as measured in terms of national prestige, human life and cost, (2) the complexity in terms of the technology required and the numbers and types of cultural contractors involved, and (3) the long period of openness in the space environment with no significant maintenance or repair possible."

Notional Astronautics and Space Administration at the Astronautics and Space Communications Division, U.S. House of Representatives, 1963.

General Electric's Apollo Support Department has been selected to assist NASA in the integration support, checkout and reliability assessment of the Apollo system. Without doubt, it takes an unusually intense and competent team to perform under the realization that the individual's work can be of significant importance to such a program.

If you are the kind of person who thrives on such responsible work, there's a place for you with General Electric. We're already put together the most experienced team ever assembled in the General Electric Company for this program. However, there are many opportunities still available to the right men. From the things below you can determine your own opportunities. **Contact Program:**

**CHECKOUT**... work centers of two distinct parts. First, a continuation of current engineering study efforts to provide NASA with checkout system analysis, standards-based studies, an integrated space vehicle checkout system specifications, modes of test procedures, the application of advanced checkout techniques to Apollo, and system checkout engineering support at NASA field centers. Second, provision of checkout equipment to be included within the integrated launch-external and checkout system.

**RELIABILITY ASSIGNMENT**... after includes analyzing NASA's existing overall mission reliability and safety levels, implementing a reliability and failure data system, and reviewing reliability and quality procedures and controls.

**INTEGRATION SUPPORT**... assist in identification and documentation of equipment and procedure interfaces within the Apollo project. Studies of integration methods and their application to Apollo including configuration control, and data handling.

### Expanding experience required in SYSTEMS and SUB-SYSTEMS CHECKOUT and TEST PLANS, DESIGNS and OPERATIONS

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Write today to Mr. P. W. Clinton, Apollo Support Department, General Electric Co., Support Building, Room 211, P. O. Box 2700, Daytona Beach, Florida. (Your inquiry will be held in strict confidence. Please include your salary requirements.)

### APOLLO SUPPORT DEPARTMENT

A Department of the Astronautics Division

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## Sikorsky Aircraft

EVALUATION COMMENTS

#### As Social Responsibility Evolves

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DIVISION OF UNITED AIRCRAFT CORPORATION  
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124 AVIATION WEEK & SPACE TECHNOLOGY, June 24, 1963

## LETTERS

### Honeycomb Defense

The most fully published comments in *Wet* by W. Eubanks (SW May 21, p. 52) regarding the choice of a TTX connector, contain misstatements of fact about leopards' connections to areas that we used early on when in the interests of our industry and of the aerospace firms which we joined. Mr. Eubanks was quoted as saying that "the TTX connector can be used by General Dynamics-Cresswell's basic 'inert launcher' that Defense Dept. experiments with it to date indicate a 'should be needed whether possible'." He also implies with the "inert launcher" structure on the North American B-1, to have delayed the development of the TTX structure by several years and thereby structure proposed by Boeing was preferable."

As it is well understood in the industry, the R-5N housework structure are based on standard steel columns. The TFS structure are generally of a fairly simple, but extremely perfect on thousands of acres. Furthermore, limited details about housework structures are available to the industry. While Mr. Ruckelshaus has been involved in the housework construction for the R-5N-3 in an engineering term, he should have been informed that the problems associated with the R-5N were peculiar to the original design of that structure and to any light-powered burning problems which may be present in that particular structure. The R-5N structure was a very complex, intricate and not a simple structure, intended to do so. We offer the following additional facts:

1. The structure of the B-Si, the only operational superionic material in the low field, is primarily of honeycomb anion sublattice.

7 Mr. Backlund revealed as was aware that the TPN dump by Shing would still have included a substantial amount of housewreck and wreck construction.

<sup>2</sup> Homoploid structures have been appearing in significant portions of both primary and secondary structures in virtually every new military aircraft design since 1914.

+ Cell aircraft, in recent years, have followed the same trend as honeycomb structure applications in military aircraft. So, even 1,000 and 2,000 sq. ft. of bonded honeycomb structure is used in every Boeing 747, 737, 727, Douglas DC-8, Conquest 350 and 990, and every currently proposed transport aircraft.

5 Honeycushion structures have even been found that way into each street in Barcelona's Model II Barrios. Medeiros and Queen et. al. maintain a low

5. Space vehicle landers are now taking advantage of the weight-saving and performance improvements offered by sandwich structural. For example, in the Saturn V program, honeycomb will be used in part of the structure of every stage of the vehicle from the 75-ft-dia. first stage through the 5-ft, 9-in. and in virtually all portions of the Apollo structure. Not one single piece of honeycomb sandwich structure at any of these stages has been designed into being for any reason except superior efficiency and performance.

*Ardenian Week* welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, *Ardenian Week*, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

7. Almost every caught spaw reliable now in white or in water spaw (at least those membership in the United States and Canada) have significant portions of the stock now dropped in honeycomb mudwax. Again, each application of honeycomb mudwax was repeated because of the continuing requirement for higher efficiency and superior performance. We hope the policy (most of the organizations involved in the above applications) is sufficient to stimulate to Mr. Macdonald that he was successful.

William S. Powell,  
President  
Powell Products, Inc.  
Escondido, Calif.

### Idlewild Walkathon

About a year and a half ago I had an unfortunate airplane accident and the ship I was flying out crashed. As a result I have been using the airlines recently, usually with comfort and consideration from the people and equipment involved.

Anyways, however, I had the experience of transferring between sidings at Milwaukee on a trip to the West. I was surprised at the conversations that have been reflected on the traveling public at this "modern" airport. I was transferring between two sidings at adjacent platforms on the money-gated, called, a terminal.

First, I had to walk a long distance to the bus. As a result of my accident I still use a cane and walking such distances for some 300 yards really is a strain. Second,

While I am an American and I read English fairly well, I pity the poor traveler from Afghanistan carrying his luggage and not being able to understand the limited news

but of direction signs which are posted. Third, it was a busy evening and, since we are a SCD with the limited intelligence that accompanies such collection, I waited in the wrong place for the bus and it was 20 min. before I boarded one. Fourth, since the bus had to circumnavigate the perimeter of the large circle, I took 31 min.

As a result, I will now avoid transferring at Minsk if possible, usually. For the

disputant, a minority position. I felt the disputant of the terminals to have suffered this discrimination upon every boundary it tried to understand. I suggest that the terminal be torn down and rebuilt in a manner that does not reflect on the intelligence of people expected to pay the consequences. We have been successful in designing, but not in synthesis. Why can't the same intelligence be used in designing input terminals suitable for entering travelers rather than driving them away?

Dana Ferguson  
Washington, State

## TFX Politics

Long before McMinn's red and blue terms were adopted to confirm the decision already handed down, my pale-purple and faded-purple terms (P G and F P) were asserting the current swing toward light colors—much known to the TEX generation.

They would be assigned to guard employees. It's amazing how people respond to such a threat. Getting drawn to business, the team began to appreciate the respective political positions of the two TPA factions. The F-16 group was assigned to Boeing and the F-15 units to General Dynamics—two were drawn. After several weeks of data gathering and computer programming, the results fell out in very few minutes. The team had to make a choice of this line:

In the final analysis they had only one input. The F.G. team added up the electoral votes of the states of Maryland, New York and Kansas and found the total about 35. Likewise the F.P.'s counted at approximately 65 in the total for Texas and New York.

Feeding this data into the computer the answer came out:

Age group	General Discomfort
0-10	1.0
11-20	1.0
21-30	1.0
31-40	1.0
41-50	1.0
51-60	1.0
61-70	1.0
71-80	1.0
81-90	1.0
91-100	1.0

This work has earned the teams permanent immunity from any sort of match effort in the future. They will be held on stand-by.

In the same final report the reviewed authors covered less than one-half a page and the summary—out of all the stuff because there was nothing in the report to support it—was not much longer.

It is recalled that there may have been advising commentators which made the adoption of Coastal Dynamics a prudent choice and in the best interest of the nation, although they were the high bidder and published hyper-indicated technical superiority in a long time. It also noted that the

It was clear, it was obvious that the players were probably not too hot off in that Chinese Dynasty and Germany should be cynical in looking a reasonably successful Japanese fighter despite the variable every impediment (there are some expensive items of lower quality).

"I want us to say that the rest of the program will be whatever it turns out to be no matter who got the contract, and that

the figures he cited about that he are only estimates. This was to reassure the people who get all upset when the program is extended at over seven billion one week, and five billion the next with nearly to 400 and

And it went up by saying that as that particular customer—the TPA plant—that General Dynamics-Congressman, because of their substantial political position, which happens to be purely a geographical loca-  
tion, would have won, hands down, if they had submitted the Fast Wash telephone book for the TPA award.

H. E. Dawson  
San Diego, Calif.

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